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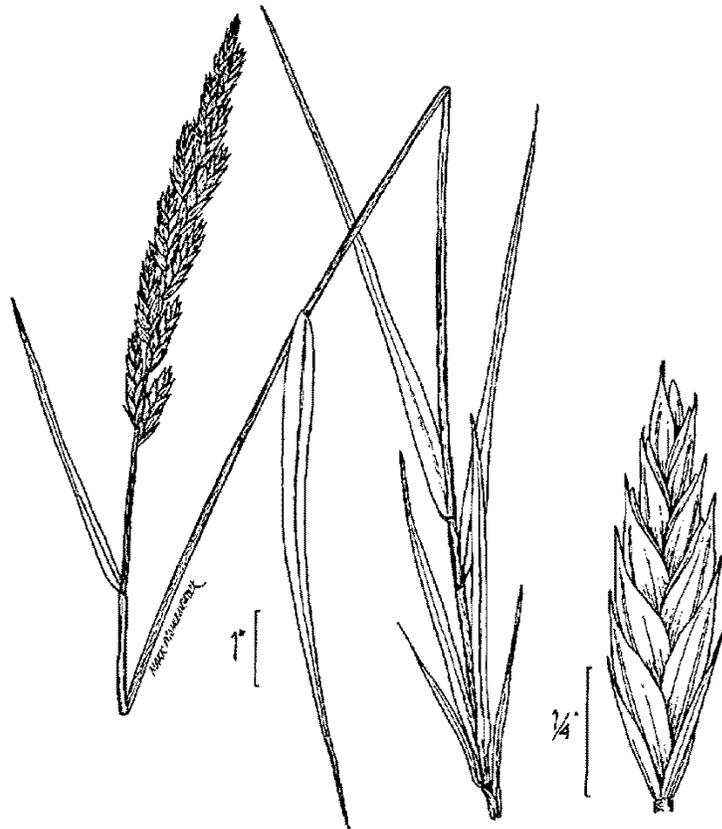
Natural  
Resources  
Conservation  
Service

Plant Materials  
Center, Bismarck,  
North Dakota

September 2014

# Technical Report, 2013

## Part 1 of 2: Grasses, Forbs, and Legumes



Western wheatgrass  
*Pascopyrum smithii*

Credit: USDA-NRCS PLANTS  
Database / USDA NRCS. *Wetland  
flora: Field office illustrated guide to  
plant species*. USDA Natural  
Resources Conservation Service.

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United States Department of Agriculture  
Natural Resources Conservation Service  
Bismarck Plant Materials Center

## Technical Report

### Part I (Grasses, Forbs, and Legumes)

2013

Plant Materials Center Advisory Committee

Mary E. Podoll, State Conservationist, North Dakota  
Jeffrey J. Zimprich, State Conservationist, South Dakota  
Don A. Baloun, State Conservationist, Minnesota

State Resource Conservationists

Todd A. Schwagler, North Dakota  
Gerald E. Jasmer, South Dakota  
Ryan Galbreath, Minnesota

Plant Materials Specialist

Wayne Markegard, Bismarck, North Dakota

Plant Materials Center Personnel

Wayne L. Duckwitz, Manager  
Craig M. Stange, Forester  
Nancy K. Jensen, Agronomist  
Earl G. Aune, Biological Science Technician (Foreman)  
Michael D. Bellon, Biological Science Technician  
Rachel H. Bergsagel, Biological Science Technician  
Julius C. Sayler, Office Automation Clerk  
Kevin M. Cortes, WAE, Seasonal Biological Science Aid  
Joseph H. Stegmiller, WAE, Seasonal Biological Science Aid  
Sage A. Malingen, WAE, Seasonal Biological Science Aid  
Jacob R. Schimetz, WAE, Seasonal Biological Science Aid

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# **INTRODUCTION**

## **INTRODUCTION: TECHNICAL REPORT – 2013**

### **Plant Materials Priorities and Needs**

The USDA, Natural Resources Conservation Service (NRCS), Plant Materials Center (PMC), Bismarck, North Dakota, primarily serves the States of Minnesota, North Dakota, and South Dakota. Activities are directed toward meeting the needs and priorities set forth in the three States' long range programs.

### **Objectives and Functions**

1. Identify, select, and improve plants to meet the resource conservation needs of the three States.
2. Determine cultural techniques for successful propagation and establishment of these plants.
3. Assemble and comparatively evaluate materials on and off the PMC.
4. Make comparative field plantings for final testing of promising plants and techniques with conservation districts and cooperators.
5. Work with universities, experiment stations, and other State and Federal agencies to cooperatively release improved conservation plants.
6. Produce limited quantities of foundation or foundation quality seed, which is made available to commercial seed growers for establishing seed increase fields.
7. Encourage conservation districts, commercial seed growers, and commercial and State nurseries to produce adapted plant materials and named cultivars.
8. Promote improved conservation plant materials in conservation programs.

**PLANT MATERIALS CENTER LONG RANGE PLAN  
BISMARCK, NORTH DAKOTA  
2006-2010**

**I. Introduction**

The mission of the Plant Materials Program is to develop and transfer effective state-of-the-art plant science technology to meet customer and resource needs. The purpose of the Plant Materials Program is to carry out specialized activities in resource conservation, as part of the overall program of the Natural Resources Conservation Service (NRCS). It is the responsibility of the Plant Materials Center (PMC) to:

1. Assemble, test, and release plant materials for conservation use.
2. Determine techniques for the successful use and management of conservation species.
3. Facilitate the commercial increase of conservation species.
4. Provide for the development and transfer of applied plant science technology to solve conservation problems.
5. Promote the use of plant science technology to meet the goals and objectives of the USDA and NRCS Strategic Plans.

The PMC Long Range Plan (LRP) identifies, guides, and directs PMC operation toward solving high-priority resource problems identified in the States' PMC LRP. The PMC LRP is consistent with goals and objectives identified in the NRCS Strategic Plan, National Plant Materials Program Strategic Plan, and State Strategic Plans. Recommended action items and specific products are identified in individual State Annual Plans which are reviewed and updated annually.

**II. Long Range Plan Development**

The LRP is in accordance with the revised National Plant Materials Manual, Part 540.22. This plan acts as a guide for directing PMC activities within Minnesota, North Dakota, and South Dakota. NRCS representatives from all three states met in Fargo, North Dakota, on March 8, 2006, to determine the basis for this plan. Feedback in the form of survey questionnaires was received from various NRCS offices, conservation districts, and partners in the three States. The "*Plant Materials Program Strategic Plan Survey Responses*" publication (2/7/05) was also used to provide insight and guidance to the decision making process.

**General Description of the Service Area**

**Climate** – USDA Plant Hardiness Zones 2, 3, 4, and 5 are within the area serviced. Precipitation is quite varied both in annual amount and in seasonal distribution, and predominantly occurs in the form of rainfall. Long-term average annual precipitation varies from 12 inches to 35 inches. The growing season ranges from 95 days to 155 days. The titles of the four Land Resource Regions include:

- Northern Great Plains Spring Wheat
- Western Great Plains Range and Irrigated
- Central Feed Grains and Livestock
- Northern Lake States Forest and Forage

A detailed description of the major land resource areas, land use, and climate may be found in the reference “*Land Resource Regions and Major Land Resource Areas of the United States,*” Agricultural Handbook 296.

### **III. Goals**

Three broad-based goals have been identified.

#### **Goal 1:**

- Identify and evaluate plants and develop technology for their successful establishment and maintenance to solve natural resource problems.

#### **Goal 2:**

- Provide plant materials and plant technology that are economically feasible for solving conservation problems and to meet emerging energy and environmental needs.

#### **Goal 3:**

- Provide equal access for all Americans to the Plant Materials Program. All products and services must be delivered fairly and equitably. Promote the increased use of plant materials to address human health, safety, cultural, and aesthetic issues.

### **IV. Plant Materials Priorities and Resource Concerns**

#### Native Prairie Ecosystems Restoration

- Identify additional species and develop sources.
- Develop establishment and management protocol.
- Market PMC releases.

#### Warm-Season Grass Promotion and Development

- Promote economic as well as conservation benefits.
- Promote the benefits of big bluestem.
- Promote proven management techniques to minimize invasive species.
- Select a switchgrass or other native species as alternatives to smooth brome grass in grassed waterways.

#### Tree and Shrub Related Technology

- Increase species diversity in windbreaks.
- Identify/develop additional tall tree species.
- Identify/develop additional native shrub species.
- Identify and promote alternatives for invasive species.

#### Wetland and Riparian Plant Materials

- Identify/develop additional species.
- Develop establishment and management protocol.

#### Saline/Alkaline Tolerant Plant Materials

- Develop and distribute information.

#### Filter Strips/Nutrient Management

- Develop/promote effective plants for nutrient uptake.

#### Streambank and Lakeshore Stabilization

- Develop establishment and management protocol.

Information, Education, and Outreach

- Promote the value of PMC releases.
- Identify and promote perennial plants for wildlife food plots.
- Remarket older plant releases.
- Target specific outreach opportunities to non-traditional clientele.

Alternative and Specialized Use of Conservation Plants

- Utilize agroforestry technology.
- Recognize alternative income species.
- Promote switchgrass as a biomass fuel for energy savings.

Urban Conservation

- Provide information on effective species/varieties.
- Promote native landscaping as low energy and reduced maintenance.
- Sell the economic as well as the environmental benefits.

**V. Partners and Cooperators**

Plant Materials Program activities are conducted in cooperation with universities, State and Federal agencies, industries, conservation groups, soil and water conservation districts and associations, and others. The primary customers are the NRCS field offices in Minnesota, North Dakota, and South Dakota. Improved plant materials will be released with cooperating agencies, Agricultural Experiment Stations, and State crop improvement associations. Seed growers and conservation nurseries will be kept informed of the availability of new plants and production techniques.

Approved by: Bismarck Plant Materials Center Advisory Committee

 WILLIAM HUNT, NRCS State Conservationist, St. Paul, Minnesota	8/31/06 Date
 JANET OERTLY, NRCS State Conservationist, Huron, South Dakota	8/31/06 Date
 J.R. FLORES, NRCS State Conservationist, Bismarck, North Dakota	8-31-06 Date

## **Location**

The Bismarck Plant Materials Center is located in south central North Dakota, near the center of the North American landmass. It is on the east bank of the Missouri River in a shallow basin 7 miles wide and 11 miles long. Elevation is 1,647 feet, latitude 46°46'N and longitude 100°45'W.

## **Physical Facilities and Evaluation Sites**

The PMC does not own land but manages a total of approximately 60 acres on Lincoln-Oakes Nursery. Three off-center evaluation sites are located in Minnesota, South Dakota, and North Dakota.

1. Lincoln-Oakes Nurseries, Bismarck, North Dakota. The USDA Natural Resources Conservation Service, Plant Materials Center operates under a cooperative working agreement with the North Dakota Association of Soil Conservation Districts (NDASCD). The Association owns and operates the Lincoln-Oakes Nursery which in turn provides the PMC with 60 acres of land located on the nursery. This site is primarily used by the PMC for foundation quality grass seed production. The PMC shares a building site with the Nursery, with the NRCS buildings located on the north part of the acreage. Buildings include an office, greenhouse, lathhouse, old office/storage building, machine storage shed (housing tree and seed storage refrigeration units), seed cleaning building, chemical storage shed, and two equipment storage buildings with one including a shop.
2. Off-center evaluation sites in Minnesota, South Dakota and North Dakota. These three other off-center evaluation sites, located in the three-State area, are cooperative with various State and Federal agencies. These locations provide long-term testing sites for plants evaluated under uniform culture and management. Refer to map, page 11.

## **Soils**

At the PMC, the soil type is a Mandan silt loam. The Mandan series typically consists of deep, well-drained soils formed in silty sediments on uplands and terraces. The surface layer is dark grayish-brown and grayish-brown silt loam 20 inches thick. The subsoil is grayish-brown silt loam 9 inches thick. The underlying material is 28 inches of light brownish-gray silt loam over light brownish-gray loam. Slopes range 0 to 7 percent. Ordinarily, surface runoff is medium and fertility is high. Controlling erosion is the major concern in management. Both soil blowing and water erosion are hazards. This soil is well-suited to small grain, corn, and alfalfa. Capability unit IIe5, Conservation Tree and Shrub Group 3.

## **Climatological Information and 2013 Weather Summary**

Climate of the area is semiarid, typically continental in character. During the summer, there are a few hot and humid days, but the winters are quite cold and fairly long. The relative humidity during the summer is generally low, and high temperature and high humidity are seldom experienced together.

Precipitation averages 17.80 inches per year. More than 75 percent of this falls during the six-month period of April through September, and 50 percent normally falls in May, June, and July. Most summer precipitation occurs during thunderstorms that occur about 34 days per year. Damaging hail occurs about once in 10 years. Refer to Table 1 for 2013 weather data.

The winter season begins in late November and continues until late March. Nearly all winter precipitation is snow, often associated with strong winds and low temperatures. Snow has been reported for all months except July and August. Occasional winter blizzards can be severe.

Temperatures range from an average mean of 6.7 degrees F in January to a mean of 70.4 degrees F in July. During short periods, the temperatures may climb as high as 100 degrees F in summer or drop as low as -44 degrees F in winter. Frequent clear and partly cloudy days contribute to a high percentage of possible sunshine, with the total annual average about 2,700 hours out of a possible 4,470 hours. The average wind speed is a little less than 11 miles

per hour, with a prevailing direction from the west-northwest in fall and winter and from the southeast in spring summer. April and May are the windiest months. The average freeze-free period is 134 days from mid-May to late September.

<b>Table 1: 2013 Weather Summary - Official Station - Bismarck, North Dakota</b>					
<b>Month</b>	<b>Mean Temperature</b>		<b>Precipitation (inches)</b>		
	<b>(degrees Fahrenheit)</b>		<b>Actual</b>		<b>Deviation from Normal</b>
	<b>2013</b>	<b>Normal*</b>	<b>2013</b>	<b>Normal*</b>	<b>2013</b>
January	13.9	12.8	0.25	0.43	-0.18
February	21.9	18.1	0.34	0.50	-0.16
March	22.7	29.9	0.83	0.86	-0.03
April	34.5	43.8	1.81	1.26	0.55
May	54.7	55.5	7.37	2.39	4.98
June	64.7	64.6	2.71	3.16	-0.45
July	70.0	71.1	1.63	2.88	-1.25
August	71.0	69.5	1.37	2.27	-0.90
September	63.8	58.5	4.36	1.59	2.77
October	42.0	44.8	4.73	1.25	3.48
November	27.6	29.2	0.09	0.71	-0.62
December	7.4	16.2	1.26	0.48	0.78
<b>Annual</b>	<b>41.2</b>	<b>42.8</b>	<b>26.75</b>	<b>17.80</b>	<b>8.97</b>
* National Climate Data Center 1981-2010 Monthly Normals					
		2013			
	Last Frost (28 degrees)	12-May			
	First Frost (28 degrees)	6-Oct			
	Frost Free Period	146 days			

## **REGIONAL DESCRIPTION**

## **REGIONAL DESCRIPTION: TECHNICAL REPORT – 2013**

### **Major Land Resource Areas**

The three States served by the PMC, Minnesota, North Dakota, and South Dakota, include portions of 23 Major Land Resource Areas in four Land Resource Regions. They are the Northern Great Plains Spring Wheat Region, Western Great Plains Range and Irrigated Region, Northern Lake States Forest and Forage Region, and the Central Feed Grains and Livestock Region.

### **Potential Natural Vegetation**

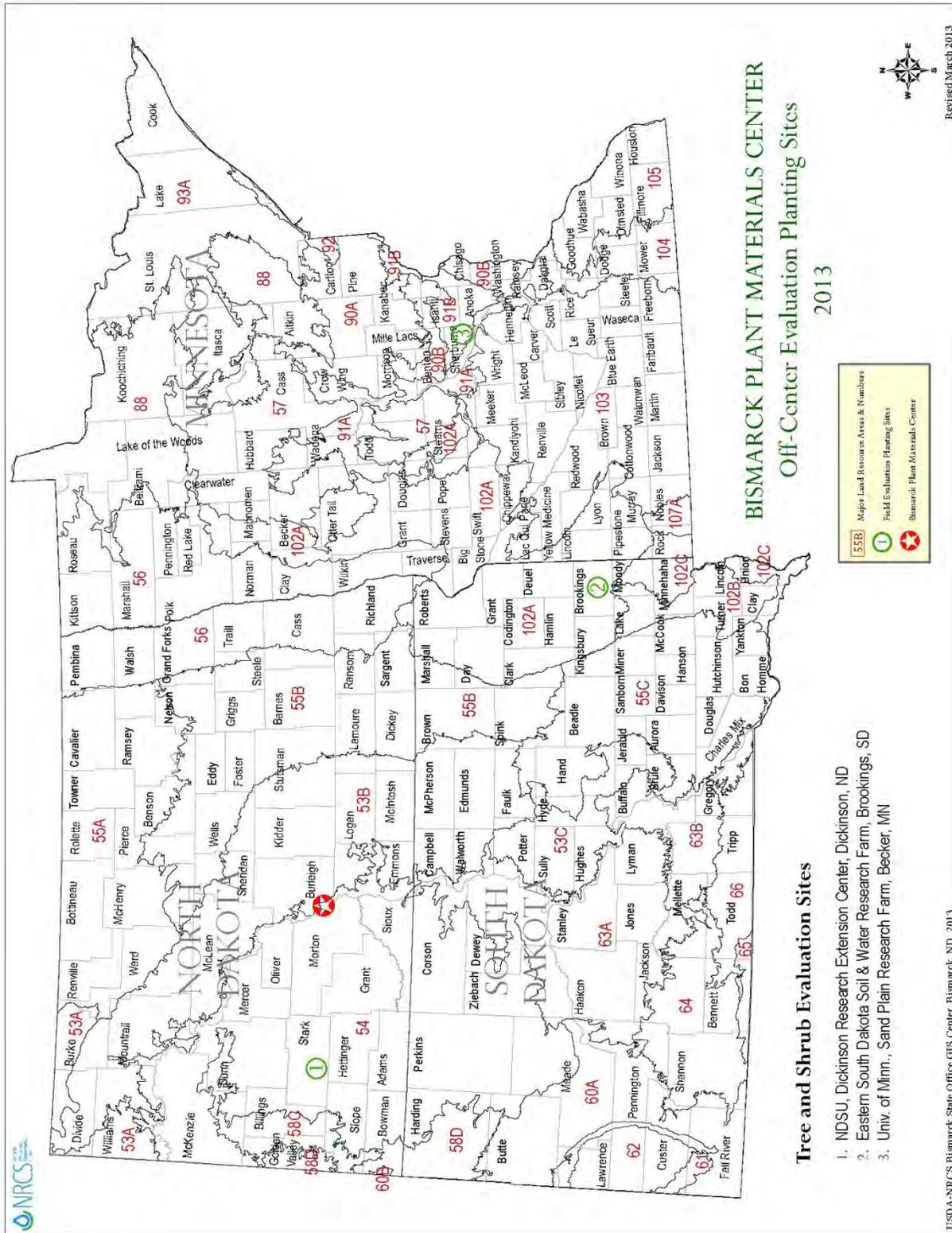
Most of central and western North and South Dakota support a mixed grass prairie of predominantly western wheatgrass (*Pascopyrum smithii*), green needlegrass (*Nassella viridula*), needleandthread (*Hesperostipa comata*), slender wheatgrass (*Elymus trachycaulus*), and prairie junegrass (*Koeleria macrantha*). Little bluestem (*Schizachyrium scoparium*), sideoats grama (*Bouteloua curtipendula*), plains muhly (*Muhlenbergia cuspidata*), sedge (*Carex*), and blue grama (*Bouteloua gracilis*) are the principal climax species on xeric soils, steeper eroded slopes or thin uplands. Prairie sandreed (*Calamovilfa longifolia*) is important on sandy soils throughout the region. Moist sites support such species as big bluestem (*Andropogon gerardii*) and prairie cordgrass (*Spartina pectinata*). Whitetop (*Scolochloa festuacea*), bulrushes (*Scirpus*), and common reed (*Phragmites australis*) are typical of lowland meadows and marshes. Western snowberry (*Symphoricarpos occidentalis*), rose (*Rosa*), buffaloberry (*Shepherdia argentea*), and chokecherry (*Prunus virginiana*) are abundant shrubs in draws and narrow valleys. Rocky Mountain juniper (*Juniperus scopulorum*) is common in the western Badlands. Eastern South Dakota, southern Minnesota, and the Red River Valley support vegetation dominated by tall grass prairie species; principally big bluestem, switchgrass (*Panicum virgatum*), and Indiangrass (*Sorghastrum nutans*). Other important species include little bluestem, prairie dropseed (*Sporobolus heterolepis*), porcupine grass (*Stipa spartea*), green needlegrass, and prairie cordgrass. Bur oak (*Quercus macrocarpa*), basswood (*Tilia americana*), hackberry (*Celtis occidentalis*), cottonwood (*Populus deltoides*), and willow (*Salix*) follow major draws and floodplains. Green ash (*Fraxinus pennsylvanica*) is found in all three states. In the western Dakotas it comprises up to 70 percent of the tall trees in forests. The presence of emerald ash borer (*Agrilus planipennis*) in Minnesota puts the ash resource at risk.

Two distinct forested regions occur within the three-State area. The first is the Black Hills of South Dakota where Ponderosa pine forest (*Pinus ponderosa*) and pine/oak savannas dominate. The second is the northern and eastern sections of Minnesota, which support mixed hardwood and conifer forests. Principal species include oak (*Quercus*), maple (*Acer*), elm (*Ulmus americana*), aspen (*Populus*), jackpine (*Pinus banksiana*), red pine (*Pinus resinosa*), and balsam fir (*Abies balsamea*). Black spruce (*Picea mariana*), tamarack (*Larix laricina*), and white cedar (*Thuja occidentalis*) are typical of lowlands and swamps.

### **Climate and Species Adaptation**

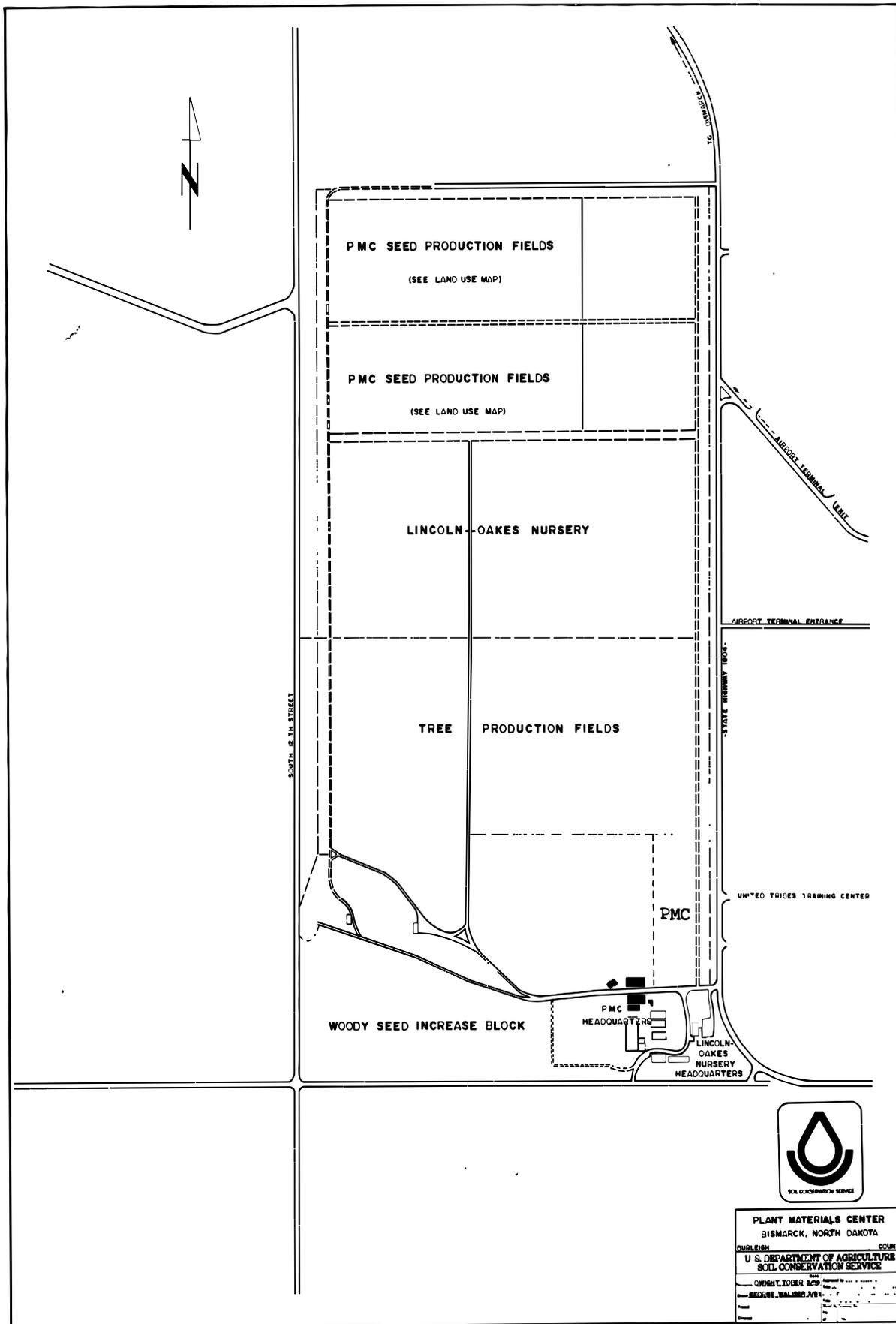
North Dakota and Minnesota are the two coldest States in the nation excluding Alaska. Mean annual temperatures range from 36 degrees F to 48 degrees F for all reporting stations. Plant hardiness zones (USDA) vary from 3 to 4 with mean minimum temperatures between -10 degrees F and -50 degrees F. Annual precipitation varies from 13 inches in western North Dakota to 30 inches or more in southeast Minnesota. Growing seasons are short, averaging from 110 to 150 days. The central and western Dakotas are principally semiarid in nature while the eastern Dakotas and Minnesota are considered subhumid.

## **MAPS**



### Tree and Shrub Evaluation Sites

1. NDSU, Dickinson Research Extension Center, Dickinson, ND
2. Eastern South Dakota Soil & Water Research Farm, Brookings, SD
3. Univ. of Minn., Sand Plain Research Farm, Becker, MN



**PLANT MATERIALS CENTER**  
 BISMARCK, NORTH DAKOTA

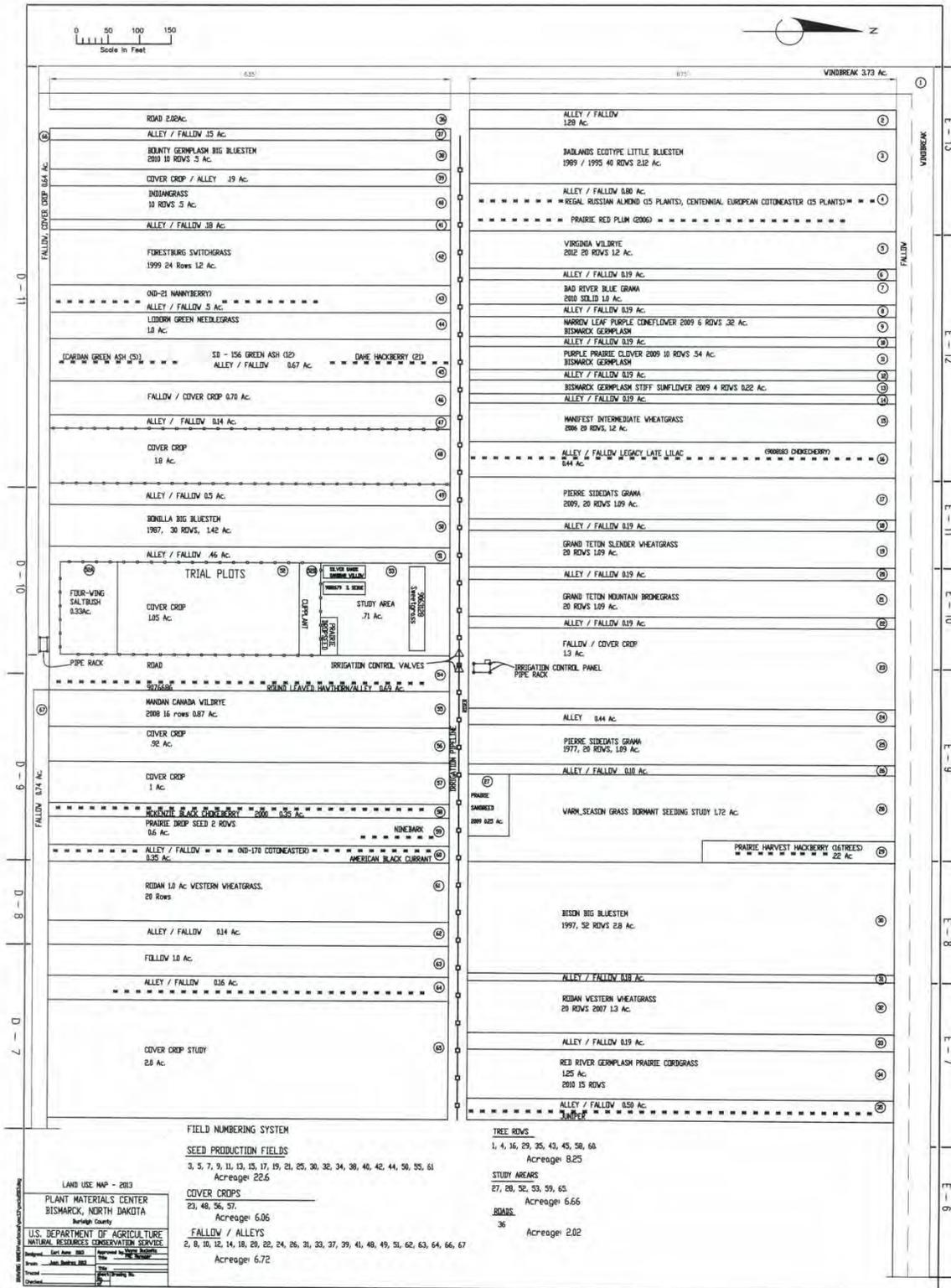
DURLEIGH COUNTY

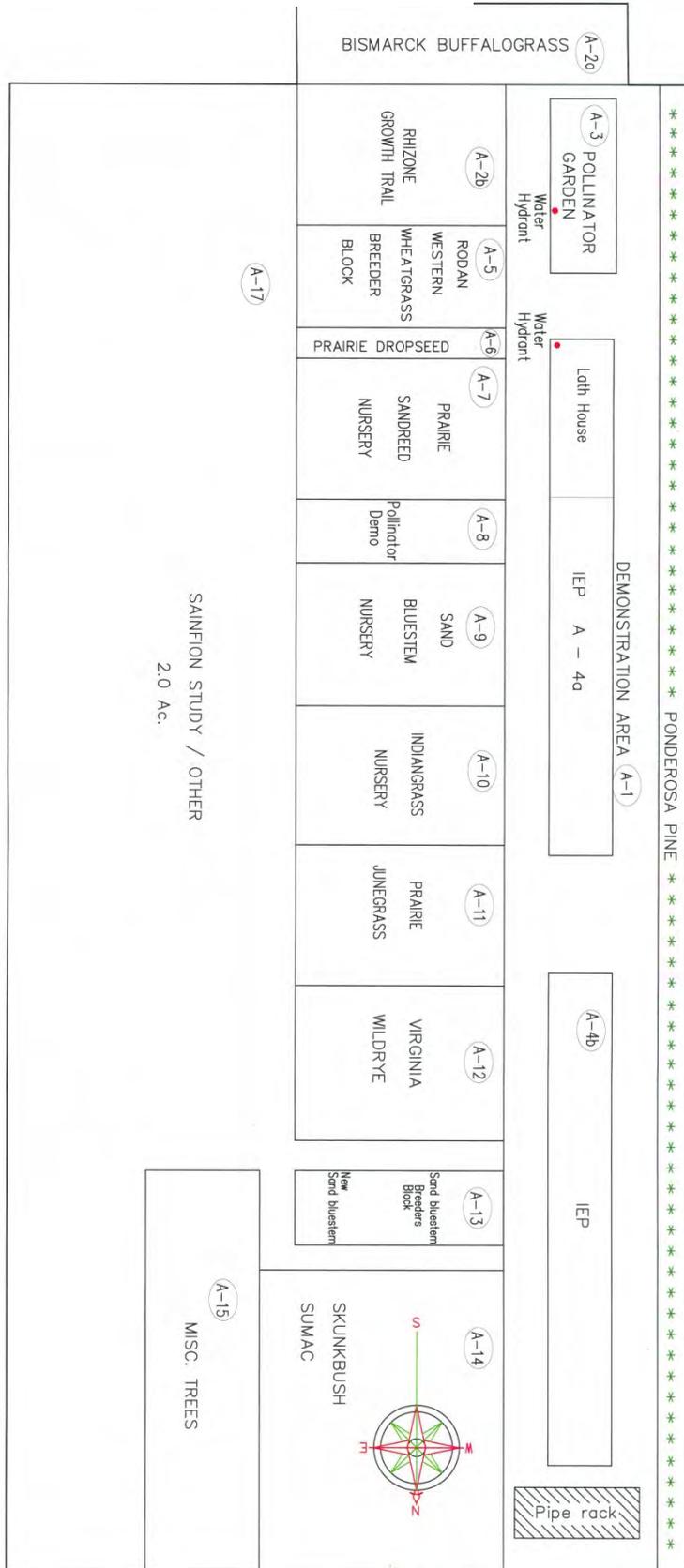
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 SOIL CONSERVATION SERVICE

CHRYSLER TOYOTA BOP

BECKMAN WALKER AVE

# PMC Land Use Map - 2013





## **ACTIVE STUDIES**

**OVERVIEW OF ACTIVE HERBACEOUS STUDIES AT THE BISMARCK PLANT MATERIALS CENTER – 2013**

Species	Use	Collection Information			Selections	Progress	2013 Accomplishments
		Year	Material	Number			
prairie sandreed	erosion control on sandy sites	2003	seed	38	7 from MN	breeder plot established in 2009	seed harvest
sand bluestem	sandy range, landscape	2003 2004	seed	21	10 preselected from MN, SD, ND	breeder population selected	reselection based on flowering date and plant characteristics, removed big bluestem phenotypes
Indiangrass	prairie seedings, wildlife, landscape	2005	vegetative	41	25 from MN	breeder plot established	breeder seed harvest
prairie dropseed	prairie seedings, wildlife, landscape	1998-2005	seed	3	3 (large seed)	breeder plot established	breeder seed harvest
prairie junegrass	prairie seedings, early forage	2006 2007	seed	97	TBD	selection	mowed panel A field, seed harvested in 2012 put in cold storage
Virginia wildrye	wildlife, tree rows, prairie seeding	2008 2009	seed seed	34 47	TBD	breeder population selected	breeder seed harvest (panel A), planted foundation seed field (E-12)
fourwing saltbush	range	1999	seed	1	1	seed increase	seed harvest
cupplant	biomass, nutrient management, riparian	2011-2012	seed	1	TBD	evaluation field planted	seed harvest
white sage	cultural outreach	On-going	vegetative	5	none	propagation bed established	distribution
sweetgrass	cultural outreach	On-going	vegetative	1	none	propagation bed established	distribution

Species	Use	Collection Information			Selections	Progress	2013 Accomplishments
		Year	Material	Number			
cover crop	soil health	2013	X	X	X	field establishment, data collection	commodity crop planted (barley), cover crop planted, soils sampled, forage clipped, laboratory analysis
quack X bluebunch	plantings in saline	2012	NewyHy ACSaltlander quack ,brome	X	X	test plot established	data collection
IEP	initial evaluation of species and varieties	X	vegetative seed	variable	X	plants established	maintenance
National Parks	park revegetation	X	X	X	3 parks-Badlands of SD, Theodore Roosevelt, Grand Teton	fields established	see park reports
Warm-Season Grass Seeding Date Study	perennial grass establishment	2013	Seed	5 warm season grass species and 1 cool season check	None	Late summer seeding, dormant seeding	Site prepared with 3 seedbed types, late summer and dormant seeding done, temp and moisture monitored
Sainfoin	Forage, erosion control	2013	Seed		X	Seeded-poor seeding	Seeded, but problems with drill-will have to reseed in 2014

**ACTIVE STUDIES: TECHNICAL REPORT 2013**

<b>Study Number</b>	<b>NDPMC-P-0104-RA</b>
<b>Title</b>	<b>Native Grasses for Conservation: Prairie dropseed <i>Sporobolus heterolepis</i></b>
<b>Objective</b>	Evaluate adaptability and growth habit of prairie dropseed. If the collections produce seed and prove adaptable and useful as a conservation species, a northern hardy release will be the goal.
<b>Duration</b>	
<b>Cooperators</b>	USDA, NRCS, Plant Materials Center, Bismarck, ND
<b>Location</b>	Bismarck Plant Materials Center
<b>-----Soils</b>	Mandan silt loam
<b>-----MLRA</b>	53B
<b>-----Precip.</b>	<b>Ave.</b> (1981-2010): 17.8 inches <b>2013:</b> 26.75 inches

**Background information:** Prairie dropseed is a warm-season perennial grass native to much of the US except westernmost and southern most states. It grows in circular tufts. It is palatable to livestock, decreasing with grazing pressure. It is desirable to wildlife for food and cover. The seedhead is an open panicle. Flowering produces a vanilla-like odor. Seeds are small, round, and shiny. Leaves are narrow and radiate from the tuft. No northern hardy release for conservation is known.

**Methods and Materials:** The study consists of three parts. The first is the assembly and evaluation of the three collections. This will be named **FIELD PLOT**. The second part of the study is evaluation of germination of prairie dropseed as it relates to seed size and age. This will be named **GERMINATION TRIAL**. The third part related to the selection of the breeder population and seed increase. This will be named **BREEDER POPULATION**.

**FIELD PLOT (seed collection began in 1998)**

<b>Seed Source</b>	<b>Accessions:</b> 9082623(ND) , 9082741(MN) , 9092028(SD) (<50 grams of seed of each was collected)
<b>-----Coll. Date</b>	See Table PD-1.
<b>-----Collector</b>	See Table PD-1.
<b>-----Location</b>	See Table PD-1.
<b>Propagation</b>	Seed was cleaned with rub board, pan screens, and SD seedblower prior to planting in the greenhouse.
<b>-----Greenhouse</b>	Seed was planted to conetainers™ in soilless potting mix. Accession 9082623(ND) was planted in 2000 and in 2002 to extend field row; accession 9082741(MN) in 2002; and accession 9092028(SD) in 2006.
<b>-----Field</b>	Seedlings from the greenhouse were planted in the separate years that they were propagated. Approximately 30-50 plants were planted for each accession.
<b>Assembly</b>	Seedlings of each accession were planted into 1 separate field row each in different years.
<b>-----Location</b>	Panel A (PMC)
<b>-----Design</b>	<b>No. of rows:</b> 3 (one per accession) <b>Row spacing:</b> 5' <b>Plant spacing:</b> 1-2'
<b>Data Collection</b>	Visual observation, measurement
<b>-----Parameters</b>	<b>2007:</b> Seed culms, culm height, leaf length <b>2001-2009:</b> seed harvest
<b>-----Data</b>	<b>Plant evaluations (2007):</b> See Table PD-2. <b>Seed harvest:</b> See Table PD-3.
<b>Field Maintenance</b>	Between rows were hand weeded and shallow tilled. No herbicide or fertilizer has been applied.
<b>-----Residue Removal</b>	<b>2005-2006:</b> burned in early April 2005 and late fall 2006. <b>2008-2009:</b> hand clipped in early spring of 2008, 2009. 2009 residue was clipped in October 2009.

### Results and Discussion (FIELD PLOT)

Germination in the greenhouse was fair for all accessions. Growth of seedlings in the greenhouse and the first year in the field was slow. Plant height at the end of the first year for the North Dakota accession was 6 inches. Few seed culms were produced for any accessions the first year. Plants of the South Dakota accession were planted late due to greenhouse heating problems. Plants were very small when transplanted to the field. The plants remained very small the first year for the South Dakota accession due to extreme heat and drought stress. Field survival was 80% or greater for all accessions. Flowering time, mid-July, appeared similar for all accessions. Spring burning appeared to stimulate seed culm production. Plants of 9092028 (SD) were more upright and crowns less dense compared to the other accessions. Buildup of residue at the crown appears to reduce seed culm production as plants age. Clipping removes some residue, but burning removes it more completely. The size, height, and seed culm numbers vary within an accession, but the variations are not great. The North Dakota accession was slightly shorter and more compact than the other two accessions. The South Dakota accession was the tallest of the three accessions, but visually had less forage. Little or no insect or disease damage was noted. There was some die back in the crown as plants aged.

### GERMINATION TRIAL (2008)

<b>Seed Source</b>	<b>Accessions:</b> 9082623, 9082741, 9092028 harvested from field rows at PMC (panel A)
<b>-----Seed Lots</b>	SCO-07-9082623, SCO-07-9082741, SCO-07-9092028
<b>-----Cleaning</b>	Office size fanning mill, once cleaned the seed was separated by weight with a SD seedblower, the smallest tube. Approximately ¼ teaspoon of seed was placed in the tube and blown for one minute. Air was opened to 3 cm. Seed remaining on the bottom of the tube after blowing was designated heavy seed. Seed that blew to the top of the column was separated by setting the column opening at 2 cm. This was designated medium weight. Light seed was discarded.
<b>Comparisons</b>	Germination comparison of heavy seed vs. medium weight seed, and germination related to storage conditions-cold storage vs room temperature.
<b>Experimental Design</b>	The experiment was run in 2008. Germination was counted for four boxes (100 seed each) of heavy seed and four boxes (100 seed each) of medium weight seed (as designated above). Four boxes of seed stored at room temperature and 4 boxes from cold storage were counted for storage portion of experiment. Seed was tested from storage just after harvest, at 6 months and after 1 year.
<b>-----Germinator Conditions</b>	Light and 30° C for 8 hours, alternated with darkness and 20°C for 16 hours. Duration of each test was 14, 21, and 28 days. Some differences in the number of days between counting occurred as a result of scheduling conflicts. Seedlings were counted at 33 days rather than 28 in April and October 2008.
<b>-----Storage Conditions</b>	Storage in the cooler was approximately 40° F and 40-50 % humidity. The exact conditions in the cooler were not recorded. Seed stored at room temperature experienced the fluctuations of temperature and humidity. Exact temperature and humidity were not recorded.
<b>Data</b>	
<b>-----Germination Trials</b>	See Table PD-4 for average germination of each treatment.

### Results and Discussion (Germination Trial)

Mold became a severe problem in the plastic germinations boxes, particularly for the October 2008 counts. Nothing was done to the seed to disinfect it prior to germinating. Seed was considered germinated if it had a root and shoot. Roots were sometimes a challenge to distinguish. It appears that seed stored in the cooler after one year generally had higher germination than the newly harvested seed or 6 month old seed. When stored at room temperature, the germination was slightly less than the newly harvested seed in most cases. The slight increase in germination after 6 months compared to freshly harvested seed indicates that there is some dormancy that may break down after 6 month or one year, if stored in a controlled climate. Size showed slight differences in germination, but not as much as anticipated. The larger seed generally showed greater germination. Seed lots also were quite different in their germination, particularly the accession

9092028 (SD). These were very young plants compared to the MN and ND accessions. This may have contributed to the low overall germination. Preliminary indications do suggest that large seed, stored in cold storage will provide the greatest germination.

#### BREEDER POPULATION

<b>Seed Source</b>	A portion of selected seed lots harvested from the Field Plot in Panel A at PMC for accessions 9082623 (ND), 9082741 (MN), and 9092028 (SD).
<b>-----9082623 (ND)</b>	Seed was harvested from 2001-2009.
<b>-----9082741(MN)</b>	Seed was harvested from 2003-2009.
<b>-----9092028 (SD)</b>	Seed was harvested from 2008-2009.
<b>Seed Selection</b>	Four random samples of 1 tablespoon each were taken from each lot year for each accession. Each tablespoon of seed was blown in 3-inch tube of SD seedblower. Each sample was blown for 1 minute with the top air open to 10. The seed remaining in the bottom of each of the 4 samples from each lot was then mixed together. This was considered the heaviest seed. Less than 50 seeds of some lots were heavy, so 4 more samples were separated to get enough seed to plant.
<b>Greenhouse Planting</b>	Seeding was first made into small flats and then plants that emerged from the flats were planted into individual pots. A soilless potting mix was used for both types of plantings.
<b>-----flats</b>	50 'heavy seeds' from each seed lot were planted on 3/5/2010 into 2 small box flats (25 seeds/flat) each. Seedlings were counted 4/15/2010.
<b>-----pots</b>	Plants growing in the flats were transplanted to 3-inch pots (one plant per pot) on 5/6/2010.
<b>Field planting</b>	Seedlings from greenhouse pots were planted to a PMC field. This was designated the breeder population.
<b>-----Accessions</b>	See Table PD-5.
<b>-----Number/Date</b>	226 seedlings were planted on 6/23/2010.
<b>-----Location</b>	Panel D-10 north of old deer fence at PMC.
<b>-----Design</b>	<b>No. of rows:</b> 9 rows <b>Row spacing:</b> 42 inches <b>Plant spacing:</b> 2 feet apart Plants of each accession were intermixed within the row and planted in a completely random order.
<b>Field Maintenance</b>	<b>2010-2013:</b> hand weed, shallow till, no fertilizer or herbicide has been applied except spot spraying of Canada thistle.
<b>-----Residue Removal</b>	<b>2010:</b> hand clipped <b>2011:</b> residue from 2011 was burned in early spring of 2012 <b>2012:</b> residue from 2012 was burned in early spring of 2013 <b>2013:</b> residue standing over winter
<b>-----Harvest (Breeder Seed)</b>	<b>Method and amount:</b> See Table PD-6.

#### Results and Discussion (BREEDER POPULATION)

Large seed was considered the criteria for developing a breeder population. Not all heavy seed that germinated in the greenhouse was surviving at field planting time. No seedlings were grown from the lighter seed. Generally, younger seed germinated and produced more seedlings in the greenhouse than the older seed. All seed had been stored in cold, dry storage prior to separation and planting. Overall, seedling growth was very slow in the greenhouse and the first year in the field.

**2013:** Plants continue to grow in width and produced more seed heads than in 2012. Plants were vigorous and showed no sign of disease. Once foliage of the plant canopies between the rows, very few weeds grow. Plans for 2014 include increasing the breeder field by seeding, rather than greenhouse plants. This will be a way to look at seedling vigor.

**Table PD-1. Collections - prairie dropseed *Sporobolus heterolepis***

<b>Date</b>	<b>Accession</b>	<b>County</b>	<b>State</b>	<b>Location</b>
10/1998; 9/8/1999 8/18/2000; 8/29/2001	9082623	Burleigh	ND	Russell Stuart Wildlife Management Area SE1/4 sec. 3-T144N-R78W
10/19/2001	9082741	Mahnomen	MN	Wambuck WMA - 5 1/2 mi. north of Mahnomen and 1 1/2 mi. east
9/27/2005	9092028	Day	SD	Pickerel Lake entrance (448th Ave.) sec. 23-T124N-R53W -large flat

**Table PD-2. Plant evaluations - prairie dropseed *Sporobolus heterolepis***

Data collectors: Jensen, Duckwitz  
 Seed culm rating: 1=many culms 3=none or very few culms  
 Culm height: average height of culms  
 Leaf length: length of leaf measured from center of crown

Planting Date	Date of Data	Accession	Plant	seed culm rating (1-3)	culm height (inches)	leaf length (inches)	Comments
2000	10/3/2007	9082623	1	1	33	18	
2000	10/3/2007	9082623	2	1	27	19	
2000	10/3/2007	9082623	3	3	29	13	
2000	10/3/2007	9082623	4	2	20	12	
2000	10/3/2007	9082623	5	1	35	17	
2000	10/3/2007	9082623	6	1	28	17	
2000	10/3/2007	9082623	7	1	34	17	
2000	10/3/2007	9082623	8	1	28	19	
2000	10/3/2007	9082623	9	1	24	15	
2000	10/3/2007	9082623	10	1	26	19	
2000	10/3/2007	9082623	11	2	36	20	
2000	10/3/2007	9082623	12	2	26	16	
2000	10/3/2007	9082623	13	1	36	16	
2000	10/3/2007	9082623	14	2	26	12	
2000	10/3/2007	9082623	15	1	34	13	
2000	10/3/2007	9082623	16	1	38	21	
2000	10/3/2007	9082623	17	2	33	16	
2000	10/3/2007	9082623	18	1	30	16	
2000	10/3/2007	9082623	19	2	32	22	
2000	10/3/2007	9082623	20	1	33	16	
2000	10/3/2007	9082623	21	1	34	20	
2000	10/3/2007	9082623	22	1	42	20	
2000	10/3/2007	9082623	23	1	31	15	
2000	10/3/2007	9082623	24	1	34	19	
2000	10/3/2007	9082623	25	3	27	10	
2000	10/3/2007	9082623	26	1	40	20	many heads
2000	10/3/2007	9082623	27	1	32	14	
2000	10/3/2007	9082623	28	2	28	17	
2000	10/3/2007	9082623	29	2	25	18	
2000	10/3/2007	9082623	30	1	32	16	red stems
2000	10/3/2007	9082623	31	3	0	11	no heads
2000	10/3/2007	9082623	32	1	20	10	
2000	10/3/2007	9082623	33	1	28	13	
2000	10/3/2007	9082623	34	2	31	18	
2000	10/3/2007	9082623	35	1	34	16	
2000	10/3/2007	9082623	36	1	36	19	
2000	10/3/2007	9082623	37	1	36	21	yellow stems
2000	10/3/2007	9082623	38	3	0	19	
2000	10/3/2007	9082623	39	2	29	13	

Planting Date	Date of Data	Accession	Plant	seed culm rating (1-3)	culm height (inches)	leaf length (inches)	Comments
2000	10/3/2007	9082623	40	2	27	13	
2000	10/3/2007	9082623	41	3	0	11	
2000	10/3/2007	9082623	42	1	32	19	
2000	10/3/2007	9082623	43	2	24	14	
2000	10/3/2007	9082623	44	3	21	13	aborted heads
2000	10/3/2007	9082623	45	2	24	15	
2000	10/3/2007	9082623	46	2	16	15	
2000	10/3/2007	9082623	47	2	30	15	
2000	10/3/2007	9082623	48	1	25	13	
2000	10/3/2007	9082623	49	3	24	17	few heads
2002	10/3/2007	9082623	50	1	30	14	
2002	10/3/2007	9082741	1	1	32	26	
2002	10/3/2007	9082741	2	3	28	23	
2002	10/3/2007	9082741	3	2	36	22	
2002	10/3/2007	9082741	4	1	46	22	
2002	10/3/2007	9082741	5	1	27	8	
2002	10/3/2007	9082741	6	2	23	13	
2002	10/3/2007	9082741	7	2	17	16	
2002	10/3/2007	9082741	8	1	36	18	
2002	10/3/2007	9082741	9	1	36	20	
2002	10/3/2007	9082741	10	1	46	21	
2002	10/3/2007	9082741	11	3	27	22	
2002	10/3/2007	9082741	12	2	31	20	
2002	10/3/2007	9082741	13	1	38	19	
2002	10/3/2007	9082741	14	1	36	20	
2002	10/3/2007	9082741	15	1	29	19	
2002	10/3/2007	9082741	16	3	15	21	
2002	10/3/2007	9082741	17	1	38	21	
2002	10/3/2007	9082741	18	2	17	22	
2002	10/3/2007	9082741	19	2	13	9	
2002	10/3/2007	9082741	20	2	32	21	
2002	10/3/2007	9082741	21	3	12	24	
2002	10/3/2007	9082741	22	1	36	19	
2002	10/3/2007	9082741	23	1	24	20	
2002	10/3/2007	9082741	24	1	34	19	
2002	10/3/2007	9082741	25	3	8	23	no culms
2002	10/3/2007	9082741	26	3	8	23	no culms
2002	10/3/2007	9082741	27	1	46	21	
2002	10/3/2007	9082741	28	2	35	18	
2002	10/3/2007	9082741	29	1	36	20	
2002	10/3/2007	9082741	30	1	38	20	
2002	10/3/2007	9082741	31	1	34	17	
2002	10/3/2007	9082741	32	2	28	8	
2002	10/3/2007	9082741	33	2	28	10	
2002	10/3/2007	9082741	34	1	34	18	

Planting Date	Date of Data	Accession	Plant	seed culm rating (1-3)	culm height (inches)	leaf length (inches)	Comments
2002	10/3/2007	9082741	35	2	29	15	
2006	10/3/2007	9092028	1	1	28	8	
2006	10/3/2007	9092028	2	3	14	10	two heads
2006	10/3/2007	9092028	3	2	30	8	
2006	10/3/2007	9092028	4	3	0	1	very small
2006	10/3/2007	9092028	5	3	0	11	no heads
2006	10/3/2007	9092028	6	2	18	8	
2006	10/3/2007	9092028	7	1	25	12	
2006	10/3/2007	9092028	8	1	15	6	
2006	10/3/2007	9092028	9	2	19	8	
2006	10/3/2007	9092028	10	3	0	8	
2006	10/3/2007	9092028	11	1	24	11	
2006	10/3/2007	9092028	12	2	23	9	
2006	10/3/2007	9092028	13	3	14	7	one head
2006	10/3/2007	9092028	14	3	16	6	two heads
2006	10/3/2007	9092028	15	1	19	7	
2006	10/3/2007	9092028	16	3	0	5	
2006	10/3/2007	9092028	17	2	23	9	
2006	10/3/2007	9092028	18	3	0	8	
2006	10/3/2007	9092028	19	1	24	7	
2006	10/3/2007	9092028	20	1	33	11	
2006	10/3/2007	9092028	21	3	12	5	two heads
2006	10/3/2007	9092028	22	1	38	13	
2006	10/3/2007	9092028	23	3	0	5	
2006	10/3/2007	9092028	24	2	14	9	
2006	10/3/2007	9092028	25	1	36	10	
2006	10/3/2007	9092028	26	3	0	4	stressed
2006	10/3/2007	9092028	27	3	0	4	
2006	10/3/2007	9092028	28	3	0	2	very small
2006	10/3/2007	9092028	29	3	22	8	two heads
2006	10/3/2007	9092028	30	3	0	5	
2006	10/3/2007	9092028	31	3	16	6	two heads
2006	10/3/2007	9092028	32	3	0	5	
2006	10/3/2007	9092028	33	3	0	7	
2006	10/3/2007	9092028	34	3	26	8	two heads
2006	10/3/2007	9092028	35	3	0	6	
2006	10/3/2007	9092028	36	2	26	12	
2006	10/3/2007	9092028	37	1	32	12	
2006	10/3/2007	9092028	38	2	26	12	
2006	10/3/2007	9092028	39	3	0	4	
2006	10/3/2007	9092028	40	3	3	3	very small

**Table PD-3. Seed harvest (Panel A) - prairie dropseed *Sporobolus heterolepis***

Accession*	State	Year	Date	Dirty	Clean bulk Yield (gm)		Cleaning Procedure**
9082623	ND	2001	09/10/01		45		
9082623	ND	2002	09/10/02		191		
9082623	ND	2003	09/22/03		211		
9082623	ND	2004	09/30/04		497		
9082623	ND	2005	09/21/05		1033		
9082623	ND	2006	09/28/06		245		
9082623	ND	2007	10/02/07	584	390		9 hole and blank, 1/4-1/2 air open, office mill, no debearder
9082623	ND	2008	09/29/08	518	344		
9082623	ND	2009	10/2009		284		
9082623	ND	2010	10/2010		477		
9082741	MN	2002	09/01/02		1.4	5 plants	
9082741	MN	2003	09/22/03		119		
9082741	MN	2004	10/01/04		357		
9082741	MN	2005	09/21/05		782		
9082741	MN	2006	09/28/06		250		
9082741	MN	2007	10/02/07	493	368		9 hole and blank, 1/4-1/2 air open, office mill, no debearder
9082741	MN	2008	09/29/08	331	195		
9082741	MN	2009	10/2009		206		
9082741	MN	2010	10/2010		165		
9092028	SD	2007	10/02/07	53	38		9 hole and blank, 1/4-1/2 air open, office mill, no debearder
9092028	SD	2008	09/29/08	592	359		
9092028	SD	2009	10/2009		560		
9092028	SD	2010	10/2010		688		

\*Date plants were planted from the greenhouse to the field: June 2000 - 9082623 (ND); June 2002 - 9082741 (MN); June/July 2006 - 9092028 (SD)

\*\*All seed was collected by hand stripping and cleaned using office debearder and office mill (unless noted)

**Table PD-4. Average percent germination - prairie dropseed *Sporobolus heterolepis* germination study**

	New Harvest* Oct-07	Six Months** Apr-08	One Year** Oct-08	
			room temp	cold storage
ND heavy	55	69	55	80
MN heavy	59	68	48	73
SD heavy	44	61	19	61
ND medium	58	60	47	75
MN medium	49	53	43	58
SD medium	30	33	3	32

\*Average percent germination after approximately 28 days

\*\*33 days for April 08 and October 08

**Table PD-5. Number of plants selected for breeder population from greenhouse seedlings -Prairie dropseed *Sporobolus heterolepis***

HV Year	9082623 (ND)	9082741 (MN)	9092028 (SD)
2001	0	x	x
2002	0	x	x
2003	4	6	x
2004	7	11	x
2005	1	0	x
2006	6	2	x
2007	15	8	x
2008	31	22	8
2009	44	30	32

x=no seed harvest, so no greenhouse pots planted

**Table PD-6. Seed Harvest (Breeder Population D-10) - prairie dropseed *Sporobolus heterolepis***

Date	Method	Amount (clean bulk)
10/14/2010	Hand harvest	58 grams
9/26/2011	hand harvest	1062 grams
9/12/2012	combine (Wintersteiger)	5 pounds
9/23/2013	combine (Wintersteiger)	12.5 pounds



Fertilizer/Irrigation: No fertilizer has been applied to the plot. Seedlings were hand watered throughout the first growing season to assist in establishment. Plants were irrigated in July of 2005 and 2006 to sustain plants during drought conditions. No other irrigation was applied.

Residue Management: Residue was hand clipped (2005-2007) or mowed with a sickle mower (2008) to a 3-4 inch stubble height in early spring of each year. Residue was removed by hand raking. Residue was removed by swathing and raking in November of 2009. Burning the residue of standing plants was attempted in November 2006. Most of the residue resisted burning and had to be hand clipped. The plot was mowed 2-3 times in 2010, 2011, 2012, and 2013 to keep weeds under control and to prevent any seed from forming and dispersing.

Evaluations: No data was collected in 2004; the year seedlings were transplanted to the field plot. Data was collected for each plant in the field plot from 2005-2008. See 2009 Technical Report for all plant data. An initial breeder population was selected in 2008 based on collected data. Forage quality was analyzed for the initially selected plants along with others from the field plot. Stalk strength was rated in April 2008 as an indicator for use in biomass projects. Plant data was reevaluated in late 2008 and early 2009. A decision was made to select plants only with Minnesota origins. Data for the final selections of the breeder population is found in Table PS-2.

Forage Analysis Sampling: Forage was sampled on 7/22/2008. Several stems were clipped from the middle of the plant. Twenty stems from each of the selected plants were used. The leaves were clipped from the top five nodes of each of the 20 stems. Stems were discarded. Leaves were oven dried at approximately 30 degrees C for 2-3 days. NIRS analysis was run by Oscar Olson Biochemistry Laboratories at South Dakota State University, Brookings. See Table PS-3 for analysis results and stalk strength ratings of selected breeder population plants.

Selection: Selections made in 2008 for the breeder population were changed in 2009 to include only Minnesota accessions. A map of 2009 selections is found in Figure PS-2. Selections were rated superior in 2007 for disease resistance. Secondary selection was based on leafiness and overall growth. Most had been selected in 2008, with only a few exceptions.

## **Breeder Population Field**

Propagation: Portions of the selected plants (2009 selections) were dug on April 21, 2009 and April 23, 2009. The pieces were then planted into large black cone-tainers™ in the greenhouse in a potting soil mix. The pieces were generally large, as prairie sandreed has a coarse, tough rhizome that usually has a sharp shoot. Fifty rhizome/root pieces were planted for each of the selections. The plants were very slow to grow in the greenhouse from the root and rhizome pieces. The breeder population crossing block (E-9) was increased in size in 2010. Additional roots and rhizomes from the selected plants in the initial evaluation block were dug and propagated in the greenhouse. A total of 296 plants were added to the crossing block in 2010. The added plants consisted of approximately 30-50 plants from each of the seven selected parent plants.

Planting Date: June 23, 2009, June 23, 2010

Location: Panel E-9 at PMC

Planting Method/Design: The plants were spaced approximately 1-2 feet apart. Trenches were made with shanks and the plants were planted into these. The trenches were spaced approximately 42 inches apart. The plants were planted in a completely randomized fashion, in relation to accession. This was to try and get a more random pollination (crossing). Many of the plants did not have well developed roots. The planted root pieces were not decayed, were still imbibing water, and had some top growth. Irrigation was started the day of planting using overhead irrigation lines. Ten rows, approximately 40 feet long, were planted in 2009. Additional rows were added in 2010.

Maintenance:

2009: The field was hand rogued and spot sprayed for weeds. No seed harvest.

2010: The field was hand rogued and spot sprayed for weeds.

2011: The field was hand rogued for weed control. Seed was harvested.

2012: The field was hand rogued for weed control. Seed was harvested using a small plot combine.

2013: The field was burned May 2, 2013 to remove residue. The field was hand rogued. Seed was harvested using a small plot combine.

A plot comparing the Bismarck PMC material (9094357) and the release, 'Koch' from the Michigan PMC were seeded into a black, firm seedbed on May 17, 2012, using a plot drill. Each plot was 5.5 feet x 80 feet. The planting was located in panel D-10 (old deer fence). Koch was the northernmost plot. Dry conditions and excessive weeds prevented adequate establishment. Plans are to reestablish the comparison plots in 2013.

## **Results and Discussion**

### **Initial Assembly**

Plants within an accession did not always perform in a similar manner in the initial evaluation block. This was expected as plants were propagated from seed, making genetics different. Due to these differences, each plant was evaluated individually. Overall, plants were very slow to establish in greenhouse and field plantings.

Plants were very slow to establish and mortality was high in 2004. Plants that survived and grew in 2005 were vigorous and began spreading by rhizomes. Plants varied in their ability to spread. There was variation in leaf width and coarseness of the plant as well. In 2005, foliar and leaf diseases manifested in certain plants. Disease was not as noticeable in 2006 compared to 2005, but some plants did exhibit severe infestations by the end of the growing season. The dry climatic conditions of 2006 were likely contributing factors. Rhizome growth and vegetative growth were strong for both years. Disease in 2005 was noted, with some accessions severely affected with stem and leaf diseases.

2007: Plants were vigorous. The differences in size and color of plants were quite noticeable. Plant disease was prominent for some accessions, causing the plants to lodge and leaves and stems to blacken. Some plants showed very little disease. Selections based on visual observations were noted.

2008: Selections for the breeder population were based on various parameters. Date of flowering, disease, and overall plant size and form were the main criteria on selection. The population selected has flowering dates that were similar. This is necessary for seed production. The plants selected also exhibited less leaf and stem rust compared to other plants. Selected plants were generally leafy, upright, and somewhat dense in stem production.

2009: The breeder population was re-selected to include only Minnesota origin accessions.

### **Breeder Population Field**

2009: Plant growth above ground was slow throughout the summer of 2009, but mortality was low. The plant height at freeze-up was 2 feet or less. Very few plants produced a seed head in 2009.

2010-2012: Plant growth continued to be slow. Little disease was noted.

2013: Leaf and stem rust was evident by September 24, 2013 on most plants. For most plants, the infection was slight. Prior to this time in 2013, very little rust or foliar disease was visible. The finer stemmed plants had less rust than the coarser, larger plants. Most plants in field produced seed heads in 2013. Plants overall were more vigorous than in previous years.

Seed Harvest:

2010: 85 gm    2011: 1.2 pounds    2012: 2.5 pounds    2013: 7 bulk (4 PLS)

**Table PS-1. Collections - prairie sandreed *Calamovilfa longifolia*.**

☐ = Final selections (2009) are shaded

Accession	State	County	Location (Section-Township-Range)	Collector
2771	SD	Corson	29-T20N-R18E	Dennis Evenson
2772	ND	McHenry	13-T153N-R76E	Mike Knudson
2773	SD	Sanborn	31-T108N-R61W	Nancy Jensen
2774	SD	Roberts	19-T122N-R52W	Nancy Jensen
2775	ND	Ransom	14&23-T135N-R53W	Nancy Jensen
2776	SD	Pennington	13-T1S-R8E	Tom Warren
2777	ND	Morton	NW of Mandan	Wayne Duckwitz
2778	SD	Kingsbury	30-T112N-R56W	Nancy Jensen
2779	SD	Faulk	33-T117N-R69W	Nancy Jensen
2780	SD	Campbell	5-T125N-R76W	Nancy Jensen
2781	ND	Adams	11&14-T129N-R92	Jim Klein, Jodi Timm
2782	SD	Brookings	12-T112N-R48W (Oak Lake)	Nancy Jensen, Dwight Tober
2783	SD	Marshall	30-T127N-R59W	Nancy Jensen
2784	SD	Brown	25&26-T128N-R60W	Nancy Jensen
2786	SD	Sully	5-T113N-R81W	Nancy Jensen, Dwight Tober
2787	SD	Tripp	9-T99N-R78W	Nancy Jensen, Dwight Tober
2788	MN	Sherburne	24-T34N-R29W	Betsy Gullickson
2789	MN	Sherburne	16-T34N-R29W	Gina Hugo
2790	MN	Sherburne	31-T34N-R28W	Gina Hugo
2792	SD	Mellette	15-T40N-R29W	Lealand Schoon
2793	SD	Todd	2-T39N-R30W	Lealand Schoon
2794	SD	Todd	26-T36N-R31W	Lealand Schoon
2813	MN	Kittson	shore of Lake Bronson	Dwight Tober
2814	MN	Polk	Agassiz Dunes	Dwight Tober
2815	MN	Norman	Prairie Smoke Dunes	Dwight Tober
2816	MN	Clay	Bluestem Prairie	Dwight Tober
2817	MN	Ottertail	Inspiration Peak Wayside Park	Dwight Tober
2818	MN	Douglas	Lake Christina (Ashby, MN)	Dwight Tober
2820	MN	Chisago	8-T33N-R21W	Mark Oja
2821	MN	Anoka	2-T33N-R23W	Mark Oja
2822	MN	Chisago	8-T33N-R21W	Mark Oja
2823	MN	Anoka	1-T33N-R23W	Mark Oja
2825	ND	Oliver	north of Cross Ranch State Park	Dwight Tober
2826	ND	McHenry	2-T154N-R75W	Wayne Duckwitz
Goshen				
ND95				
<b>No Seed Fill or Failed in Greenhouse</b>				
2770	SD	Lyman	35-T107N-R72W	Dwight Tober, Nancy Jensen
2785	SD	Stanley	36-T6N-R30E	Dwight Tober, Nancy Jensen
2791	MN	Sherburne	34-T34N-R27W	Gina Hugo
2819	MN	Wabasha	7-T109N-R9W	Mark Oja

**Figure PS-1. Plot layout - prairie sandreed *Calamovilfa longifolia*.**

Location: Panel A

Planted: 7/6/2004

West



Rep 1			Rep 2			Rep 3				
Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8	Row 9	Row 10	Row 11
ND95	2817	2818	Goshen	ND95	2789	2784	Goshen	2818	<b>p2 2788</b>	2820
<b>p2 2820</b>	2778	<b>p3 2815</b>	2816	2825	2813	2826	2773	2817	2783	ND95
2825	2776	2813	2782	2783	<b>p2 2818</b>	2774	2774	<b>p2 2814</b>	2784	2816(2)
2780	2771	2793	2823	2792	2775	2776	2771	2815	2781	2787(1)
2783	2774	2789	2822	<b>p3 2814</b>	2773	2817	2772	2813	2780	2786(2)
2788	2773	2784	2779(2)	2778	2772	2794	2775	2794	2825	2823(2)
2792	2772	2781	2790	2771	2777	2788	2776	2792	2826	2822(3)
2794	2775	2826	2787	2821	<b>p1 2815</b>	2780	2778	2793	2821	2786(1)
2814	2777	2821	2786	2781	2793	2820	2777	2789	Goshen	2790(1)
										2816(2)
										2787(1)

**Final selections(2009) p = plant number (from west)**

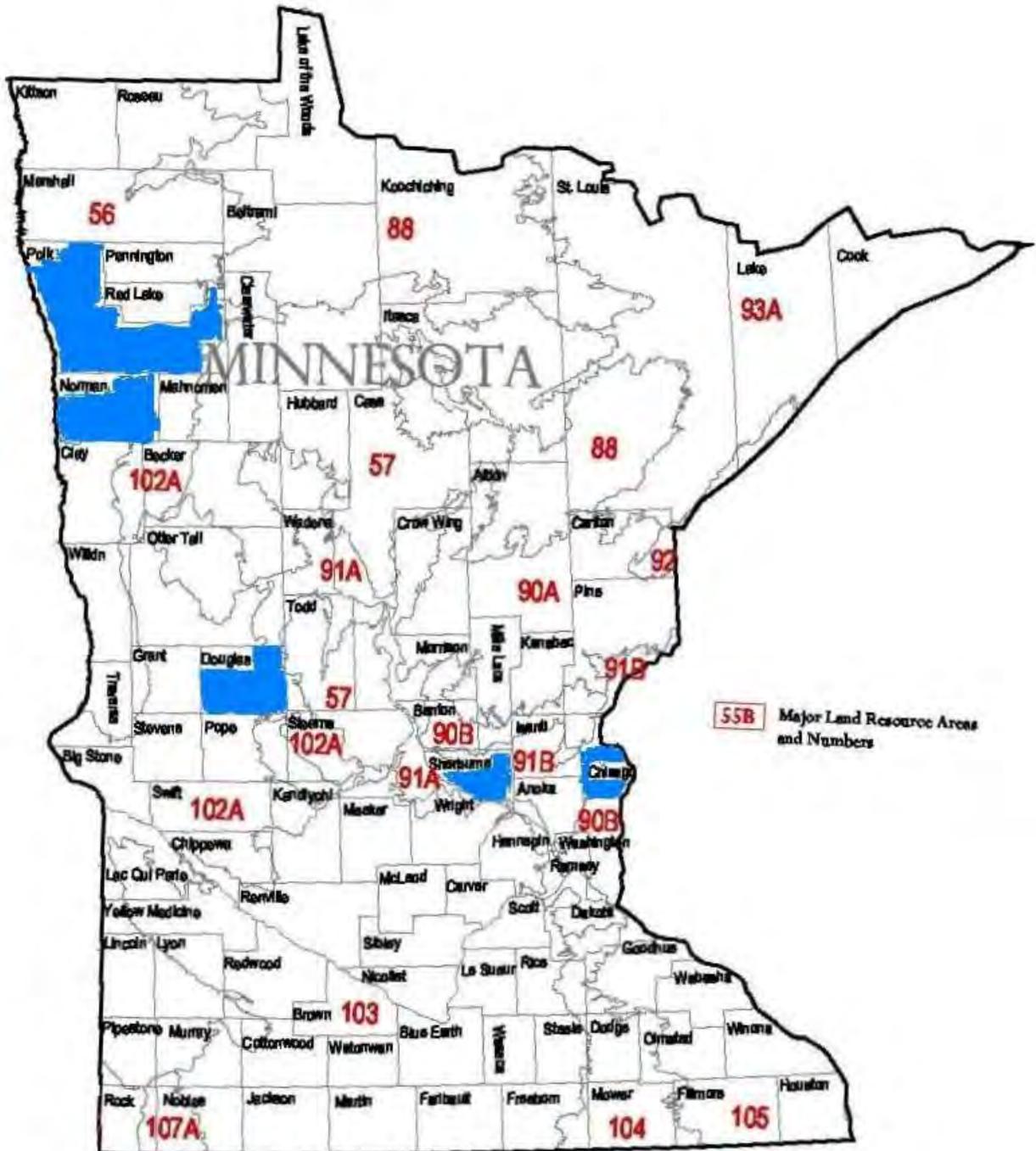
Seedlings were grown in the greenhouse. Seedlings were in very poor condition when field planted.

Row spacing: 3 1/2 feet between plants and 3 1/2 feet between rows

The prefix for each accession is 908.

Accessions are in 3 plant plots unless designated in ( ).

Figure PS-2. Minnesota map showing county origins of the selected prairie sandreed *Calamovilfa longifolia* accessions.



**Table PS-2. Evaluation data 2005, 2006, and 2007 of Breeder Population - Prairie sandreed *Calamovilfa longifolia*.**

**Key:**  **1-3 rating scale**

Leaf width: 1=narrow, fine 3=wide, coarse  
 Leafiness: 1=many leaves 3=few leaves  
 Disease: 1=lack of disease 3=severe  
 Seed culms: 1=many 3=few or none  
 Lodging: 1=none 3=severe  
 Size: 1=large, robust 3=small

**1-9 rating scale**

Leafiness: 1=many leaves 9=few leaves  
 Disease: 1=lack of disease 9=severe  
 Vigor: 1=excellent vigor 9=poor vigor

EW=east-west spread (inches)  
 NS=north-south spread (inches)

\*Accn=accession (908 prefix)

\*\*sel=selected for conservation in 2007

\*\*\*lsp sel=selected for landscaping in 2007

Date	908 Accn*	Row	Plant no.	(in.) Culm height	(in.) Veg. height	(in.) EW spread	(in.) NS spread	rating Leaf width	rating Leaf-iness	rating Di-sease	rating Seed culms	No. of culms	rating Vigor	rating Lodging	rating Size	** sel	*** lsp sel	Comments	
08/26/05	2788	10	2	34	18	7	8	2	3	2		3	3						
08/04/06	2788	10	2	69		24	27	3	2		1								short, wide
08/07/07	2788	10	2						1	1	1			2	1	x			
08/26/05	2814	5	3	73	13	5	9	3	2	2		17	3						
08/04/06	2814	5	3	77		29	23	1	2		1								fine leaves
08/07/07	2814	5	3						1	1	2			3	1				
08/26/05	2814	9	2	47	16	12	8	2	4	3		2	3						
08/04/06	2814	9	2	54		19	13	2	2		2								
08/07/07	2814	9	2						2	1	1			2	2	x			blue
08/26/05	2815	3	3	42	5	3	3	3	6	2		3	3						
08/04/06	2815	3	3	49		15	13	1	2		2								clean
08/07/07	2815	3	3						1	1	2			1	2				leafy, fine leaves
08/26/05	2815	6	1	0	20	9	3	3	5	4		0	3						
08/04/06	2815	6	1	45		15	13	2	1		3								blue, leafy
08/07/07	2815	6	1						1	1	2			1	2	x			
08/26/05	2818	6	2	46	9	10	7	2	4	5		8	4						
08/04/06	2818	6	2	52		23	17	2	2		1								leafy
08/07/07	2818	6	2						1	1	1			1	2	x			
08/26/05	2820	1	2	48	26	7	11	2	3	2		4	3						
08/04/06	2820	1	2	60		15	20	2	2		3								stressed, lodged
08/07/07	2820	1	2						2	1	3			2	2				

**Table PS-3. Forage analysis, stalk strength, and phenology - Prairie sandreed *Calamovilfa longifolia*.**

Test Date	908 Accn*	Row	Plant No.	Forage Quality Analysis**					Rating 4/3/2008	7/28/2008 Phenology	Origin	
				CP	ADF	NDF	RFV	RFQ	Stalk Strength***		State	County
8/7/2008	2788	10	2	13.6	40.7	75.1	71	89	3	late boot	MN	Sherburne
8/7/2008	2815	3	3	14.6	39.8	70.2	77	100	2	pre-anthesis	MN	Norman
8/7/2008	2820	1	2	13.7	35.5	65.6	87	129	--	late boot	MN	Chisago
8/7/2008	2814	9	2	16.1	35.5	68.6	83	127	--	--	MN	Polk
8/7/2008	2815	6	1	14.1	39.0	70.9	77	110	--	--	MN	Norman
8/7/2008	2818	6	2	15.9	38.1	71.5	77	102	--	--	MN	Douglas

plants selected for breeder population in 2009 (Accn # 2814 Row 5, Plant 3 was not clipped for forage analysis as it was selected after forage analysis)

\* Accn=accession (908 prefix)

\*\* Forage Quality: CP = crude protein, ADF = acid detergent fiber %, NDF = neutral detergent fiber %, RFV = relative feed value, RFQ = relative feed quality; forage was sampled 7/22/2008

\*\*\* Stalk strength: 1=upright, 3=lodged

Data for stalk strength and phenology were not recorded for all of the collections that had forage analysis. This was due to selection and 2 reselections before deciding a final selected population.

**ACTIVE STUDIES: TECHNICAL REPORT 2013**

<b>Study Number</b>	<b>NDPMC-P-0402-RA</b>
<b>Title</b>	<b>Sand Bluestem Seed Increase (<i>Andropogon hallii</i>)</b>
<b>Objective</b>	Develop a sand bluestem release from native collections from Minnesota, North Dakota, and South Dakota. Superior plants will be selected and the release would be intended for conservation plantings on sandy sites in Minnesota, North Dakota, and South Dakota. A priority of the release would include seed production.
<b>Duration</b>	2003-2016
<b>Cooperators</b>	USDA, NRCS, Bismarck Plant Materials Center, Bismarck, North Dakota
<b>Location</b>	Plant Materials Center, Bismarck, ND
<b>-----Soils</b>	Silt loam
<b>-----MLRA</b>	
<b>----- Precip.</b>	Normal: 17.80 inches 2013: 26.75 inches

**Background information:** Species available for stabilizing sandy soils are limited. Sand bluestem is a tall, perennial, warm-season grass native on sandy sites in the Great Plains. It has short rhizomes. The culms are solid. The seed heads are racemes forming a turkey foot shape and closely resembling big bluestem. It is distinguished from big bluestem by its dense yellow hairs on the seed head and its lack of hairs on the leaves. Its growth habit and forage quality are important attributes when used in conservation plantings. Current releases adapted to the Northern Great Plains are ‘Garden’ and ‘Goldstrike’. They are marginally adapted in the northern portion of the Great Plains and production of seed is very inconsistent.

**Methods and Materials**

The study is divided into two sections. The sections are: Initial Assembly and Breeder Population. Seeds from the collections were grown in the greenhouse and planted to an initial assembly. Data was collected from plants in the initial assembly and superior plants, based on visual performance and seed set, were then selected to be part of the breeder population.

**Initial Assembly**

<b>Seed Source</b>	
<b>-----Collection</b>	See Table SB-1 for collection information (Date, location, collector, accession) Small amounts of seed were hand harvested from native plants for each collection.
<b>Propagation</b>	
<b>-----Greenhouse</b>	<b>2005:</b> Seed was planted into conetainers™ in February, soilless potting mix, hardened off in lath house.
<b>Assembly</b>	Seedlings grown in the greenhouse were planted into field.
<b>-----Location</b>	Panel A (southern end)
<b>-----Date</b>	5/24/2005
<b>-----Design</b>	Three replications, accessions in three-plant plots, accessions random within a replication. See Figure SB-1 for plot layout. Plants and rows were spaced 3.5 feet apart.
<b>Field Maintenance</b>	
<b>-----Weed Control</b>	Frequent shallow tilling each year with walk behind front tine garden tiller, no herbicide except spot spraying of Canada thistle, hand hoeing.
<b>-----Irrigation</b>	No irrigation except in 2005 at seedling transplant, and July 2006 during severe drought.
<b>-----Residue Removal</b>	<b>2005:</b> hand clipped in November to a 3-inch stubble height. <b>2006:</b> attempted to burn but not successful. Hand clipped in November. <b>2007:</b> no residue removal. <b>2008:</b> hand clipped residue from 2007 growth in April 2008. <b>2009:</b> swathed and raked off residue in November. <b>2010:</b> residue left standing. <b>2011:</b> Residue from 2010 burned off in spring. <b>2012:</b> mowed and raked in November. <b>2013:</b> no residue removed.

<b>Data Collection</b>	See Table SB-2 for collected data.
<b>-----Parameters</b>	Canopy spread, culm height, leaf width, leafiness, seed heads, lodging, overall size, stalk strength, phenology (flowering stage).
<b>-----Data</b>	See Table SB-2 for collected data. Data was collected from 2005-2008. See 2009 Technical Report for all data.

### **Breeder Population**

<b>Source</b>	
<b>-----Selections</b>	Selections were based on flowering time, leafiness, and overall plant health. Some plants were also identified as big bluestem or hybrid and are labeled 'ANGE" in the table.
<b>-----Propagation</b>	Plants were propagated in 2011 from root and rhizome pieces. Portions of selected plants in the initial assembly were dug and planted the same day to the breeder population block.
<b>-----Date</b>	May 6, 2011
<b>Propagation</b>	
<b>-----Field</b>	Each of the 10 selected plants were cut into 10 chunks and moved to breeder block on May 6, 2011.
<b>Assembly</b>	Superior plants were selected from initial assembly and chunks were planted May 5, 2011 to form breeder block.
<b>-----Location</b>	Panel A (northern end)
<b>-----Design</b>	Selected accessions randomly assembled into 10 plants X 10 row plot. Plants spaced 3.5 feet apart.
<b>Data Collection</b>	See Table SB-2 for collected data.
<b>Field Maintenance</b>	
<b>-----2012</b>	Hand weeding, shallow tillage with garden tiller.
<b>-----2013</b>	Hand weeding, shallow tillage with garden tiller, removal of plants with big bluestem characteristics.

### **Results and Discussion**

**2012:** Plants initially grew slow after transplanting. Plants that had the most typical color and hairiness of sand bluestem were flagged as selections from the population.

**2013:** Some plants exhibited big bluestem characteristics by the end of the growing season. Plants that did not appear to be big bluestem were reflagged. The big bluestem plants will be removed in 2014 and reselection will be made for the breeder population. Seed production will be greatly considered when selecting the final breeder population.

**Table SB-1. Collections – sand bluestem *Andropogon hallii***

Accession	State	County	Date	Legal Description	Collector
9082894	SD	Harding	09/14/03	Sec.30, T15N, R5E SE of N Crow Butte	L.Smith
9082803	ND	Adams	09/02/03	SW1/4 Sec.11 and NE1/4 of Sec.14, T129N, R92W Roadway	J.Klein, J.Timm
9082804	ND	Ransom	09/08/03	Sec. 14 and Sec.23, T135N, R53W Sheyenne Grasslands	N. Jensen
9082805	ND	McHenry	09/24/03	Sec.20, T158N, R75W, Mouse River State Forest	M.Knudson
9082806	ND	McHenry	09/24/03	Sec.13, T153N, R76W road ditch SE of George Lake	M.Knudson
9082807	SD	Corson	09/23/03	Sec.29, T20N, R18E flat area	D.Evenson
9082808	ND	Ransom	09/09/03	Sec.27,34 T135N, R53W 2mi N of Hwy 27 along 147 Ave. N	N. Jensen
9082809	SD	Brown	09/09/03	NE1/4 26, SW1/4 25, T128N, R60W 1mi from Brown/Marshall Co. line	N. Jensen
9082810	SD	Todd	09/19/03	SW1/4 19, T36N, R29W N of county road	L.Schoon
9082811	SD	Todd	09/19/03	NW1/4 Sec.25, T36N, R31W, 3/4mi W Hwy S of St. Francis	L.Schoon
9082812	SD	Todd	09/19/03	SE1/4 Sec.9, T36N, R28W 1/2 mi W of Hwy 83, N edge of county road	L.Schoon
9082824	ND	Billings	10/01/03	SW1/4 Sec.22, T139N, R103W along Little Missouri River	M.Humann
9082827	ND	McHenry	09/15/03	NW1/4 Sec.2, T75N, R154W east of farm	W.Duckwitz
9082881	MT		2003	Sec.25, T11N, R48E	T.Haughain, Kilian
9082904	ND	Burleigh	09/09/03	Sec.7, T137N, R77W Moffit Rd west of curve	Jensen, Bergsagel
9082905	ND	Emmons	09/23/04	4 mi S. of Glencoe Church, Hwy 1804, east side of road	D.Tober
Garden	KS			Received from Manhattan, KS PMC	
sher1	MN	Sherburne	09/04/03	Sec.27, T34N, R27W Sand Dunes State Forest, east exposure	G.Hugo
sher2	MN	Sherburne	09/04/03	Sec.4, T133N, R28W non-cropped pivot corner	B.Gullickson
sher3	MN	Sherburne	09/04/03	SESE Sec.15, T34N, R27W old Christmas tree plantation	G.Hugo
sher4	MN	Sherburne	09/04/03	Sec.24, T34N, R29W Oak Savannah Land preserve (county park)	B.Gullickson
sher5	MN	Sherburne	09/04/03	Sec.16, T34N, R29W & Sec.31, T34, R28 along railroad tracks	B.Gullickson

**Figure SB-1. Plot layout - Sand Bluestem *Andropogon hallii*.**

(Plants were started in conetainers in the greenhouse from collected seed)

Plant spacing: 42 inches (3.5 ft.)

Row spacing: 42 inches (3.5 ft.)

Plants Selected for Breeder Population



Garden	9082811	9082809	9082806	sher5	9082881
Garden	9082811	9082809	9082806	sher5	9082881
Garden	9082811	9082809	9082806	sher5	9082881
9082827	9082905	9082881	9082807	9082806	sher3
9082827	9082905	9082881	9082807	9082806	sher3
9082827	9082905	9082881	9082807	9082806	sher3
9082810	sher5	9082811	sher3	9082812	9082810
9082810	sher5	9082811	sher3	9082812	9082810
9082810	sher5	9082811	sher3	9082812	9082810
9082809	9082807	sher5	9082810	9082804	Garden
9082809	9082807	sher5	9082810	9082804	Garden
9082809	9082807	sher5	9082810	9082804	Garden
9082806	9082904	9082804	9082812	9082809	9082803
9082806	9082904	9082804	9082812	9082809	9082803
9082806	9082904	9082804	9082812	9082809	9082803
9082803	sher3	Garden	sher2	9082811	9082905
9082803	sher3	Garden	sher2	9082811	9082905
9082803	sher3	Garden	sher2	9082811	9082905
9082808	sher2	9082803	9082904	sher2	9082904
9082808	sher2	9082803	9082904	sher2	9082904
9082808	sher2	9082803	9082904	sher2	9082904
9082881	9082804	9082905	9082808	9082808	9082807
9082881	9082804	9082905	9082808	9082808	9082807
9082881	9082804	9082905	9082808	9082808	9082807
9082812	9082894	9082827	blank	9082827	9082824
9082812	9082894	9082827	blank	9082827	sher4
9082812	9082894	9082827	blank	9082827	sher1

**Table SB-2. Evaluations of Selected Plants for Breeder Population- Sand bluestem *Andropogon hallii*.**

**Key**

- Canopy spread:** width of plant, inches
- Culm height:** height of plant including seed culm, inches
- Leaf width:** 1=fine, narrow; 2=medium; 3=wide
- Leafiness:** 1=many leaves; 2=medium; 3=few leaves
- Seed heads:** 1=many; 2=medium; 3=few or none; y=yes; n=no
- Lodging:** 1=none, slight; 2=medium; 3=severe
- Overall size:** 1=large; 2=medium; 3=small
- Stalk strength:** 1=upright; 2=lodged; 3=severe lodging (after winter)
- Phenology:** flowering stage

Date	Accession	Row	Plant No.	(inches) Canopy spread	(inches) Culm height	rating Leaf width	rating Leafiness	rating Seed heads	rating Lodging	rating Overall Size	rating Stalk strength	Phenology	rating Seed Fill	Comments
09/13/05	9082806	1	1					y						
08/04/06	9082806	1	1	29	48	2	1	1						
08/07/07	9082806	1	1				1	1	1	1				gray green
04/03/08	9082806	1	1								1			
07/29/08	9082806	1	1				2					boot		
08/21/09	9082806	1	1						1					
09/22/09	9082806	1	1										1	
09/13/05	9082806	1	3					y						leafy
08/04/06	9082806	1	3	21	51	2	1	1						very upright
08/07/07	9082806	1	3				1	1	1	1				gray green
04/03/08	9082806	1	3								1			
07/29/08	9082806	1	3				1					pre-anthesis		
09/13/05	sher4	6	1					y						
08/04/06	sher4	6	1	26	42	2	1	1						
08/07/07	sher4	6	1					1	1	1				yellow green
04/03/08	sher4	6	1								1			
07/29/08	sher4	6	1				1					pre-anthesis		
08/21/09	sher4	6	1						1					
09/22/09	sher4	6	1										1	
09/13/05	9082806	5	1					y						2 small culms

Date	Accession	Row	Plant No.	(inches) Canopy spread	(inches) Culm height	rating Leaf width	rating Leafiness	rating Seed heads	rating Lodging	rating Overall Size	rating Stalk strength	Phenology	rating Seed Fill	Comments
08/04/06	9082806	5	1	8	48	2	3	1						
08/07/07	9082806	5	1				2	2	1	2				
04/03/08	9082806	5	1								1			
07/29/08	9082806	5	1				2					pre-anthesis		
09/13/05	9082807	4	3					y						flowering
08/04/06	9082807	4	3	26	51	2	3	1						
08/07/07	9082807	4	3				2	2	1	1				
04/03/08	9082807	4	3								1			
07/29/08	9082807	4	3				2					pre-anthesis		
08/21/09	9082807	4	3						1					
09/22/09	9082807	4	3										2	
09/13/05	9082808	1	1					y						
08/04/06	9082808	1	1	21	36	1	1	2						boot
08/07/07	9082808	1	1				1	1	1	1				yellow green
04/03/08	9082808	1	1								1			
07/29/08	9082808	1	1				1					boot		
08/21/09	9082808	1	1						1					
09/22/09	9082808	1	1										3	
09/13/05	9082808	1	2					n						
08/04/06	9082808	1	2	17	45	2	2	2						powder blue, boot
08/07/07	9082808	1	2				2	2	1	2				
04/03/08	9082808	1	2								1			
07/29/08	9082808	1	2				1					boot		
09/13/05	9082881	1	1					y						small
08/04/06	9082881	1	1	20	45	2	2	2						
08/07/07	9082881	1	1				2	2	2	2				
04/03/08	9082881	1	1								1			
07/29/08	9082881	1	1				2					anthesis		
09/13/05	9082881	6	1					n						
08/04/06	9082881	6	1	21	45	2	2	2						
08/07/07	9082881	6	1				2	2	2	2				

<b>Date</b>	<b>Accession</b>	<b>Row</b>	<b>Plant No.</b>	<b>(inches) Canopy spread</b>	<b>(inches) Culm height</b>	<i>rating</i> <b>Leaf width</b>	<i>rating</i> <b>Leafiness</b>	<i>rating</i> <b>Seed heads</b>	<i>rating</i> <b>Lodging</b>	<i>rating</i> <b>Overall Size</b>	<i>rating</i> <b>Stalk strength</b>	<b>Phenology</b>	<i>rating</i> <b>Seed Fill</b>	<b>Comments</b>
04/03/08	9082881	6	1								2			
07/29/08	9082881	6	1				2					pre-anthesis		
08/21/09	9082881	6	1						1					
09/22/09	9082881	6	1										2	
09/13/05	9082905	6	3					y						
08/04/06	9082905	6	3	20	60	3	1	1						big bluestem?
08/07/07	9082905	6	3				1	1	1	1				coarse
04/03/08	9082905	6	3								1			
07/29/08	9082905	6	3				1					pre-anthesis		

## **ACTIVE STUDIES: TECHNICAL REPORT 2013**

### **Study NDPMC-P-0404-RA**

**Study Title:** Evaluation and Increase of Indiangrass *Sorghastrum nutans*

**Objective:** The objective of the study is to evaluate and release an Indiangrass with Minnesota origins that is adapted to Minnesota and the Dakotas. Its purpose will be for prairie, forage, and wildlife plantings. The initial purpose of this study was to identify and release an Indiangrass for use in urban and rural landscaping and to identify and release another population of Indiangrass for forage production and wildlife habitat. The objective was changed due to priorities of the PMC program and to changes in seed origin requirements and preferences in Minnesota.

**Cooperators:** USDA, NRCS, Bismarck Plant Materials Center; University of Minnesota; South Dakota State University, Brookings, South Dakota

**Description:** Indiangrass is a tall, native, warm-season grass that is bunchy, but has short, stout rhizomes. It grows 2-6 feet in height. The leaves are often a gray-green color and are somewhat stiff and straight. The attractive seedheads are panicles that are reddish gold and softly hairy.

**Distribution:** Indiangrass is most commonly associated with big bluestem and switchgrass in tallgrass prairies. It is found in southeast Canada, through much of the central and eastern United States, and into Mexico. It is not generally found west of the Great Plains. It prefers deep, well-drained floodplain soils and moister conditions than big bluestem.

### **Methods and Materials - Initial Assembly**

**Collection:** Portions of plants were dug from an existing Indiangrass nursery at the north corner of the Agronomy Farm, South Dakota State University. The nursery had been planted in the 1970s-1980s from seedlings started from two seed collections, one from Aurora, east of Brookings, South Dakota, and one from an area around Yankton, South Dakota. Plants from the two sources could be distinguished by their leaf width and texture. The Yankton source, which is a more southern source had wider, coarser leaves than the Aurora source plants. Plants that were colorful or had unusual growth favorable for landscaping were flagged in the fall of 2004 by Dwight Tober and Nancy Jensen, PMC personnel; Dr. Mary Meyer, University of Minnesota; and Dr. Arvid Boe, South Dakota State University. Portions of the selected plants were dug the following spring on April 12, 2005, from the Brookings nursery. One portion of each selection was delivered to Dr. Mary Meyer at the University of Minnesota Arboretum, and the remaining portion was taken to the Plant Materials Center. Additional Indiangrass plants were collected at native sites in Minnesota. These were grown only at the PMC.

The plant/root remained dormant in a cool, dark tree cooler prior to greenhouse planting. Plantlets were separated from root chunks collected at SDSU and native locations. Each individual plantlet was planted into Miracle Grow Potting Mix in cone-tainers™ and placed in the greenhouse on April 25, 2005. Propagules were planted on June 7, 2005, to a field plot in panel A. The plants in the greenhouse were very slow to grow in size. Plants were hardened off in the lath house for two weeks prior to planting in the field.

**Assembly:** See Table IG-1 for accession information.

**Planting Plan:** Plantlets were planted to a field north of the sand bluestem in Panel A at the PMC. Each accession was planted in a three-plant plot. The accessions were randomized within the three replications. Plants were spaced 42 inches apart and rows were 42 inches apart. See Figure IG-1 for field plot map.

**Site Preparation:** The field was black fallowed for a few years, then tilled and packed within a week of planting. Previous plant material in the field was *Carex atherodes*.

**Planting Method:** Plants were hand planted using a specially made dibble bar that produces holes the size and length of roots within the cone-tainers™.

Field Planting Date: 4/12/2005

Maintenance: Weeds have been controlled from 2005-2009 by shallow tilling with a small walk-behind tiller when weeds are small (less than 3 inches) and hand rogueing. The plot has received no fertilizer. Irrigation has been minimal. Plants were irrigated in July and on September 23, 2005, and once in July 2006. Plants were not irrigated in 2007-2009. Herbicide was applied only as a spot spray on small Canada thistle patches in 2005 and 2006. The herbicides used were Curtail and Roundup.

Data Collection: Notes on survival and a few comments on color were noted in 2005. This was the transplant year, so no extensive data was collected. Data collected in 2006 included plant height, leafiness, and culms produced. Data was collected twice in 2007. Data collected in September 2007 indicated seed ripeness. Growth stage was rated in 2008. See Table IG-2 for data. Preliminary selections were made for a landscaping population and a forage population. Plants were flagged. The breeder population was reselected in 2009. A decision was made to select only Minnesota origin plants. Data from previous years, flowering date, and overall plant performance in 2009 of Minnesota plants were considered when making plant selections. Growth stage was recorded August 5, 2009. See Table IG-3. The standard of comparison was the variety Tomahawk.

### **Methods and Materials - Breeder Population**

All selected accessions for the breeder population are of Minnesota origins. Selected plants (see Table IG-3) were propagated in the greenhouse. A portion from each selected plant growing in the initial assembly (Panel A) was dug in April 2010 and the root material split into small plantlets. These were planted in containers and grown in the greenhouse until planting to the breeder field (field D-11). The number of plants propagated and planted to the breeder field for each selected accession is found in Table IG-3. Plantlets were space planted on 6/7/2010. Rows were spaced 42 inches apart and plants within the rows were planted approximately 2 feet apart. A total of 10 rows (approximately 100 feet long) were planted. There was little or no mortality of plants in the breeder block in 2010. The selected accessions appear leafier than Tomahawk Indiangrass and flowering is 1-2 weeks earlier than Tomahawk.

A small amount of seed was hand harvested in 2010. A total of 978 grams bulk of clean seed remained after cleaning 6.77 pounds of dirty seed.

In 2011, plants that had ripe seed in early and mid August were considered to be early flowering. These plants were individually sprayed with glyphosate on September 21, 2011. Once the plants died, they were dug and removed from the field. Approximately 10-20 % of the total number of plants in the field were removed. As selected accessions were randomly planted when the breeder field was established, there is no way to determine the exact origin of each removed plant.

#### 2012 Maintenance:

April 25	Burned 2011 residue
May 1	atrazine at 2 pints/acre applied
May 16	fertilizer 46-0-0 at 73 lb N/ac applied
June 12	2,4-D at 1 oz/gal
Throughout growing season	Hand rogueing
September 10	Seed was combine harvested

#### 2013 Maintenance:

May 2	Burned 2012 residue
May 5	Sprayed Atrazine and Plateau at 2 pt/ac
May 9	Fertilized with 46-0-0 at 79 lb N/ac
June 6	Sprayed Curtail at 2 pt/ac
June 27	Sprayed Buctril at 1 pt/ac

### **Results and Discussion - Assembly**

Plant survival in the greenhouse and field in 2005 was greater than 90 percent. Some color differences between plants were displayed. Plant growth was excellent in 2006, despite drought conditions. Differences in phenology and growth characteristics were exhibited. A few accessions produced viable seed before a killing frost. Some plants displayed an upright stature and color variation, making them desirable for landscaping. Plants that were leafy and had finer leaves showed potential for forage production. Size, color, and leaf width were variable between accessions in 2008. Attempts to measure stalk strength by rating lodging after overwintering was not possible. All plants were standing on 4/3/2008. A major factor in selection of a forage population is expected flowering date, which is important for seed production. The plants were leafy and vigorous. See Table IG-2 for data.

The primary use for Indiangrass will be Minnesota and portions of eastern North Dakota and eastern South Dakota. Minnesota requirements mandating the use of Minnesota origin seed for state funded and other seedings impacted the selection process. Plants selected are leafy and vigorous. Smut, which has not been noticed in past years, was present on many seedheads throughout the evaluation block. Plants with noticeable smut were not selected.

### **Results and Discussion - Breeder Field**

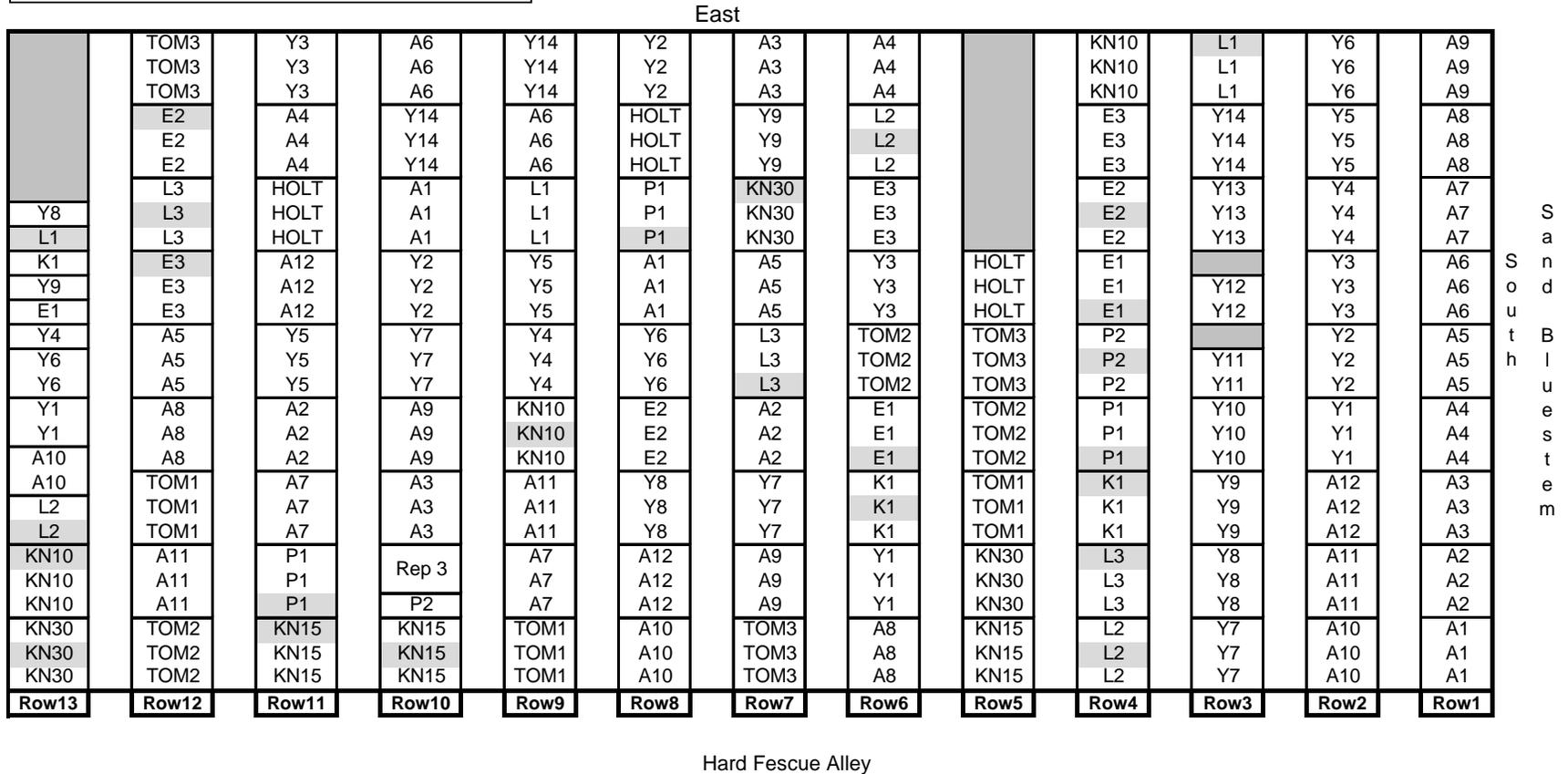
The plants that remain after removing the very early maturing maintained some variation in flowering dates. The plants also exhibited variation in a number of plant characteristics including leaf width, and plant height. Seed harvested in 2012 was 67 pounds of dirty seed, which cleaned out to 38 bulk pounds. The 2012 seed only had 47% germination, which is quite low. In 2013, seed harvested was 110 pounds of dirty seed (from combine). Clean amount is pending. The cause of low germination is not known. It may be due to poor conditions for pollination or may be due to chemical application. To better assess the selection, plans in 2014 include a comparison trial with Tomahawk and Holt or Chief Indiangrass. Data will be collected on flowering, leafiness, and seed production.

**Table IG-1. Collections - Indiangrass *Sorghastrum nutans*.**

ID No.	Accession	State	County	Location
A1	9091979	A1 - A12		Vegetative material dug 4/12/2005 from Dr. Arvid Boe's assembly at SDSU Agronomy Farm east of campus, just west of I-29 and at SDSU Research Farm near Aurora, east of I-29. Original material had been collected by Dr. Ross of SDSU in the 1970's from the Aurora Prairie east of Brookings.
A2	9091980			
A3	9091981			
A4	9091982			
A5	9091983			
A6	9091984			
A7	9091985			
A8	9091986			
A9	9091987			
A10	9091988			
A11	9091989			
A12	9091990			
Y1	9091991			
Y2	9091992			
Y3	9091993			
Y4	9091994			
Y5	9091995			
Y6	9091996			
Y7	9091997			
Y8	9091998			
Y9	9091999			
Y10	9092000			
Y11	9092001			
Y12	9092002			
Y13	9092003			
Y14	9092004			
L1	9092005	MN	Redwood	U of M SW Outreach and Research Center, Lamberton, near Cottonwood River in native prairie
L2	9092006	MN	Redwood	U of M SW Outreach and Research Center, Lamberton, near Cottonwood River in native prairie
L3	9092007	MN	Redwood	U of M SW Outreach and Research Center, Lamberton, near Cottonwood River in native prairie
K1	9092008	MN	Douglas	near Kensington, MN between road and railroad
P1	9092009	MN	Redwood	coll. 4/13/2005 Lamberton Twp, Sec.29, 2 miles from Revere along Pell Cr., Brian Pfarr landowner
P2	9092010	MN	Redwood	coll. 4/13/2005 Lamberton Twp, Sec.29, 2 miles from Revere along Pell Cr., Brian Pfarr landowner
E1	9092011	MN	Sherburne	coll. 4/13/2005 Elk River FO, Gina Hugo, T33N. R27 NW1/4of SW1/2 sec14
E2	9092012	MN	Sherburne	coll. 4/13/2005 Elk River FO, Gina Hugo, T33N. R27 NW1/4of SW1/2 sec14
E3	9092013	MN	Sherburne	coll. 4/13/2005 Elk River FO, Gina Hugo, T33N. R27 NW1/4of SW1/2 sec14
KN10	9092017	MN	Kittson	SW1/4 SE1/4 Sec.10 T160N R 46W(Norway Township) fine and medium sands, Al Gustafson
KN15	9092018	MN	Kittson	NW1/4 NE1/4 Sec.15 T160N. R46W(Norway Township) loamy fine sand, Al Gustafson
KN30	9092019	MN	Kittson	NE1/4 SE1/4 Sec.30 T160N. R46W(Norway Township) Arveson fine sandy loam, Al Gustafson
Tom1	9092014	ND		PMC field
Tom2	9092015	ND		PMC field
Tom3	9092016	ND		PMC field
Holt		NE		seed from KS PMC, started in the Greenhouse
H1	NONE	MN	Pine	Hinkley FO, Julie Lindner, SCT, Pine Co., MN SE1/4 of NE1/4 Sec.20 T39N R21W - poor root sample

Figure IG-1. Plot layout - Indiangrass *Sorghastrum nutans* .

Species: **Indiangrass** *Sorghastrum nutans*  
 Location: **Panel A**  
 Planting Date: 6/7/2005  
 Spacing between rows = 42 inches (3.5 feet)  
 Spacing between plants = 42 inches (3.5 feet)



**Table IG-2. Evaluation data, 2006-2009 - Indiangrass *Sorghastrum nutans*.**

**Key:**

**Ratings**

- Leaf width: 1=narrow; 2=medium; 3=wide
- Texture: 1=fine leaves, stem 2=medium 3=coarse leaves, stem
- Leafiness: 1=many leaves; 2=some leaves; 3=few leaves
- Seed culms: 1=many culms; 2=some culms; 3=few culms
- Phenology: 1=seed forming; 2=flowering; 3=boot
- Growth Stage as related to flowering/seed production
- Lodging: 1=no lodging; 2=some lodging; 3=severe lodging
- Plant Size: 1=large, robust; 2=medium to large; 3=small
- Color: 1=very colorful, showy; 2=some color; 3=not showy
  
- Culm Ht.: seed culm height (inches)
- Spread: width of plant crown (inches)
- Select: L=landscape, F=forage potential selections

Date	Accession	ID No.	Row	Plt. No.	Leaf Width	Texture	Leafiness	Seed Culms	Culm Ht. (in.)	Phenology	Growth Stage	Mature Seed	Spread (in.)	Lodging	Plt. Size	Color	Select	Comments
08/04/06	9092005	L1	3	3	3		1	3	45				24					boot
08/07/07	9092005	L1	3	3			2			2				2	1	2		
09/25/07	9092005	L1	3	3								1						
07/30/08	9092005	L1	3	3		3					boot							
08/9/09	9092005	L1	3	3							No heads							
08/04/06	9092005	L1	13	1	3		1	1	48				35					upright
08/07/07	9092005	L1	13	1			2			2				2	1	1		
09/25/07	9092005	L1	13	1								2						
07/30/08	9092005	L1	13	1		3					boot							
08/09/09	9092005	L1	13	1							No heads							
08/04/06	9092006	L2	4	2	2		1	2	39				34					boot
08/07/07	9092006	L2	4	2			1			3				2	1	2		
09/25/07	9092006	L2	4	2								1						light colored heads
07/30/08	9092006	L2	4	2		2					vegetative							
08/09/09	9092006	L2	4	2							No heads							
08/04/06	9092006	L2	6	2	3		1	2	39				30					boot
08/07/07	9092006	L2	6	2			1			3				1	1	2	F	late
09/25/07	9092006	L2	6	2								1						slight bluegreen
07/30/08	9092006	L2	6	2		2					boot							

Date	Accession	ID No.	Row	Plt. No.	Leaf Width	Texture	Leafiness	Seed Culms	Culm Ht. (in.)	Phenology	Growth Stage	Mature Seed	Spread (in.)	Lodging	Plt. Size	Color	Select	Comments
08/09/09	9092006	L2	6	2							No heads							
08/04/06	9092006	L2	13	1	2		1	2	39				22					boot
08/07/07	9092006	L2	13	1			1			3				2	1	2	F	late
09/25/07	9092006	L2	13	1							1							bluegreen, leafy
07/30/08	9092006	L2	13	1		2					early boot							
08/09/09	9092006	L2	13	1							boot							
08/04/06	9092007	L3	4	3	2		1	2	45				38					boot
08/07/07	9092007	L3	4	3			2			2				2	1	2		
09/25/07	9092007	L3	4	3							1							
07/30/08	9092007	L3	4	3		2					vegetative							
08/09/09	9092007	L3	4	3							No heads							
08/04/06	9092007	L3	7	1	2		1	2	30				29					boot
08/07/07	9092007	L3	7	1			2			2				2	2	2		
09/25/07	9092007	L3	7	1							1							very fine leaf, leafy
07/30/08	9092007	L3	7	1		2					vegetative							
08/09/09	9092007	L3	7	1							No heads							
08/04/06	9092007	L3	12	2	3		1	2	42				28					
08/07/07	9092007	L3	12	2			2			2				2	2	2		
09/25/07	9092007	L3	12	2							1							upright, leafy
07/30/08	9092007	L3	12	2		2					vegetative							
08/09/09	9092007	L3	12	2							No heads							
08/04/06	9092008	K1	4	3	2		2	2	51				34					
08/07/07	9092008	K1	4	3			1			2				2	1	2	F	
09/25/07	9092008	K1	4	3							1							
07/30/08	9092008	K1	4	3		2					vegetative							
08/09/09	9092008	K1	4	3							No heads							
08/04/06	9092008	K1	6	2	2		1	2	54				34					
08/07/07	9092008	K1	6	2			2			2				2	1	2		
09/25/07	9092008	K1	6	2							1							
07/30/08	9092008	K1	6	2		2					boot							
08/09/09	9092008	K1	6	2							No heads							
08/04/06	9092009	P1	4	1	3		1	3	33				37					boot
08/07/07	9092009	P1	4	1			1			2				2	1	2	F	
09/25/07	9092009	P1	4	1							1							

Date	Accession	ID No.	Row	Plt. No.	Leaf Width	Texture	Leafiness	Seed Culms	Culm Ht. (in.)	Phenology	Growth Stage	Mature Seed	Spread (in.)	Lodging	Plt. Size	Color	Select	Comments
07/30/08	9092009	P1	4	1		2					early boot							
08/09/09	9092009	P1	4	1							No heads							
08/04/06	9092009	P1	8	1	3		1	2	30				39					boot
08/07/07	9092009	P1	8	1			2			3				2	1	2	F	late
09/25/07	9092009	P1	8	1								1						
07/30/08	9092009	P1	8	1		2					vegetative							
08/09/09	9092009	P1	8	1							No heads							
08/04/06	9092009	P1	11	1	3		1	2	42				27					boot
08/07/07	9092009	P1	11	1			1			3				2	1	2	F	
09/25/07	9092009	P1	11	1								2						
07/30/08	9092009	P1	11	1		2					early boot							
08/09/09	9092009	P1	11	1							No heads							
08/04/06	9092010	P2	4	2	3		2	3	39				26					boot
08/07/07	9092010	P2	4	2			2			3				2	2	2		
09/25/07	9092010	P2	4	2								2						
07/30/08	9092010	P2	4	2		2					early boot							
08/09/09	9092010	P2	4															
08/04/06	9092011	E1	4	1	2		2	1	63				18					
08/07/07	9092011	E1	4	1			2			2				2	2	2		
09/25/07	9092011	E1	4	1								1						
07/30/08	9092011	E1	4	1		2					late boot							
08/09/09	9092011	E1	4	1														
08/04/06	9092011	E1	6	1	1		1	2	60				26					
08/07/07	9092011	E1	6	1			2			2				2	2	2		
09/25/07	9092011	E1	6	1								1						
07/30/08	9092011	E1	6	1		2					late boot							
08/09/09	9092011	E1																
08/04/06	9092012	E2	4	2	3		2	2	66				18					
08/07/07	9092012	E2	4	2			1			2				2	1	2	F	upright
09/25/07	9092012	E2	4	2								1						
07/30/08	9092012	E2	4	2		2					early anthesis							
08/09/09	9092012	E2																
08/04/06	9092012	E2	12	3	2		1	1	63				18					

Date	Accession	ID No.	Row	Plt. No.	Leaf Width	Texture	Leafiness	Seed Culms	Culm Ht. (in.)	Phenology	Growth Stage	Mature Seed	Spread (in.)	Lodging	Plt. Size	Color	Select	Comments
08/07/07	9092012	E2	12	3			1			1				1	1	2	F	upright, early
09/25/07	9092012	E2	12	3								1						
07/30/08	9092012	E2	12	3		2					late boot							
08/09/09	9092012	E2	12	3														
08/04/06	9092013	E3	12	3	3		2	2	63				22					
08/07/07	9092013	E3	12	3			2			2				2	1	2		
09/25/07	9092013	E3	12	3								1						few leaves
07/30/08	9092013	E3	12	3		2					first anthesis							
08/09/09	9092013	E3	12	3														
08/04/06	9092017	KN10	9	2	2		2	2	48				28					
08/07/07	9092017	KN10	9	2			2			1				2	2	2		black seed
09/25/07	9092017	KN10	9	2								1						bluegreen, fine leaf
07/30/08	9092017	KN10	9	2		1					anthesis							
08/09/09	9092017	KN10	9	2														
08/04/06	9092017	KN10	13	3	3		2	2	45				30					
08/07/07	9092017	KN10	13	3			2			1				2	2	1		black seed, blue leaves
09/25/07	9092017	KN10	13	3								1						fine leaf, basal
07/30/08	9092017	KN10	13	3		1					anthesis							
08/09/09	9092017	KN10	13	3														
08/04/06	9092018	KN15	10	2	2		2	2	51				28					
08/07/07	9092018	KN15	10	2			2			1				1	2	2		
09/25/07	9092018	KN15	10	2								1						short, leaves basal
07/30/08	9092018	KN15	10	2		1					anthesis							
08/09/09	9092018	KN15	10	2														
08/04/06	9092018	KN15	11	3	2		3	2	48				23					
08/07/07	9092018	KN15	11	3			2			1				2	2	2		
09/25/07	9092018	KN15	11	3								1						leaves basal
07/30/08	9092018	KN15	11	3		1					anthesis							
08/09/09	9092018	KN15	11	3														
08/04/06	9092019	KN30	7	3	1		2	2	42				26					
08/07/07	9092019	KN30	7	3			2			1				2	2	2		
09/25/07	9092019	KN30	7	3								1						
07/30/08	9092019	KN30	7	3		1					anthesis							

Date	Accession	ID No.	Row	Plt. No.	Leaf Width	Texture	Leafiness	Seed Culms	Culm Ht. (in.)	Phenology	Growth Stage	Mature Seed	Spread (in.)	Lodging	Plt. Size	Color	Select	Comments
08/09/09	9092019	KN30	7	3							anthesis							
08/04/06	9092019	KN30	13	2	2		1	2	42				31					
08/07/07	9092019	KN30	13	2			2			2				2	2	2		
09/25/07	9092019	KN30	13	2								1						
07/30/08	9092019	KN30	13	2		1					anthesis							
09/22/09	9092019	KN30	13	2							½ anthesis							

**Table IG-3. Selections – Indiangrass *Sorghastrum nutans***

Indiangrass Selections 9/22/2009

\*plant 1=west most plant of accession

Selections made on appearance, size, seed heads

Breeder block planted 6/7/2010

Accession	ID No.	MN County	Row	Plant*	Total Planted 2010
9092011	E1	Sherburne	4	1	25
9092011	E1	Sherburne	6	1	23
9092012	E2	Sherburne	4	2	25
9092012	E2	Sherburne	12	3	20
9092013	E3	Sherburne	12	3	18
9092008	K1	Douglas	4	3	23
9092008	K1	Douglas	6	2	22
9092017	KN10	Kittson	9	2	25
9092017	KN10	Kittson	13	3	24
9092018	KN15	Kittson	10	2	19
9092018	KN15	Kittson	11	3	21
9092019	KN30	Kittson	7	3	25
9092019	KN30	Kittson	13	2	22
9092005	L1	Redwood	3	3	17
9092005	L1	Redwood	13	1	19
9092006	L2	Redwood	4	2	25
9092006	L2	Redwood	6	2	23
9092006	L2	Redwood	13	1	20
9092007	L3	Redwood	4	3	14
9092007	L3	Redwood	7	1	22
9092007	L3	Redwood	12	2	22
9092009	P1	Redwood	4	1	19
9092009	P1	Redwood	8	1	22
9092009	P1	Redwood	11	1	15
9092010	P2	Redwood	4	2	21

## **ACTIVE STUDIES: TECHNICAL REPORT 2013**

Study: NDPMC-P-0604-RA

Study Title: Evaluation of Prairie Junegrass (*Koeleria macrantha*)

Introduction: Prairie junegrass is a cool-season native grass that grows in small tufts. It has been described as excellent forage for livestock, deer, and elk early in the spring. As the grass is small, its production is low. The quality declines at maturity. It is one of the earliest grasses to begin vegetative growth in the spring. It is easily overgrazed and decreases with increased grazing pressure. It is a component of many native plant communities. No adapted release of prairie junegrass is currently available for revegetation and native seedings in the Northern Great Plains.

Objective: The purpose of this study is to evaluate, identify and assemble a population of prairie junegrass from Minnesota, North Dakota, and South Dakota origins into a public release for conservation seedings in the Northern Great Plains.

Cooperators: USDA, NRCS, Bismarck Plant Materials Center, Bismarck, North Dakota

Description: Prairie junegrass is a short to medium lived, cool-season, perennial bunchgrass that is 6-20 inches tall. The roots are fibrous. Leaves are mostly basal. The seed head is a condensed panicle that opens slightly during flowering. Growth in the spring is usually completed by mid-June.

Distribution: Junegrass is native to most of North America, except the far southeast. It is also native to Europe and Northern Asia. It is very common in mixed grass and shortgrass prairie, meadows, open forest, mountain foothills, and rangeland. It is best adapted to well-drained soils in 12-20 inch precipitation areas.

### **Methods and Materials**

Collection/Assembly: Seed heads were collected in 2006 and 2007 by NRCS employees from Minnesota, North Dakota, and South Dakota. See Table PJ-1 for collection and origin information. Seed heads were clipped at maturity and sent to the Plant Materials Center where they were accessioned and placed in the seed cooler for storage until seed was separated and planted in the greenhouse. Seed was planted into a soilless potting mix in cone-tainers™. Seedlings were planted from the greenhouse to a field plot (Panel A) on 5/21/2008. Seedlings were hand planted using a custom made dibble bar. See Figure PJ-1 for a map of the planting. Some collections did not have viable seed or emerge in the greenhouse. Plants were irrigated after planting to fill any space around the roots.

Maintenance:

2009: Weeds were controlled by shallow tilling between the rows with a garden tiller and hand hoeing around plants.

2010: Weeds were controlled by shallow tillage between rows, and hand hoeing around plants

2011: Weeds were controlled by shallow tillage between rows, and hand hoeing around plants. Plant residue was removed by mowing in early fall.

2012: Mowing between rows was used to control weeds.

Data Collection:

2009: Superior looking plants were grouped into categories based on growth habit and the use of the plant. The categories included landscaping, prairie/range or both. These are indicated in Table PJ-2.

2010: Data was collected in June for each plant. Plants were rated for height, number of culms, leafiness, and growth stage. Data for all plants is found in the previous Technical Report (2010).

2011: Plants that were dead or had poor vigor, disease, or flowered very early or very late were dug and removed from the planting. Superior plants of the remaining plants were noted and categorized as forage or landscape type plants. The removed plants are indicated on the map (Figure PJ-1) All data for the plants that remained after 2011 selection are recorded in Table PJ-2.

2012: Most of the stand was dead in the spring of 2012. As rows within the planting could not be identified, individual remaining plants could not be identified by accession. Seed was hand harvested from the remaining plants in the late summer of 2012. The amount of clean seed harvested was 0.29 bulk pounds.

2013: Seed harvested in 2012 was cleaned and is being stored in seed cooler for any future evaluation. The assembly area in Panel A was mowed. Seed that had fallen in previous years germinated and produced a healthy solid turf where the spaced plants had previously been assembled.

### **Results and Discussion**

Seed fill is difficult to determine in prairie junegrass. Plants in the greenhouse were small to handle, but transplanting from flats to cone-tainers™ was very successful. Seedling survival after planting to the field was greater than 90 percent. Most of the plants flowered or had seed heads in 2009. Plants showed an array of sizes. Wide variability in size exists among the plants. Some plants are also very hairy on the leaves and stem, while others are smooth.

The loss of the stand in 2012 was very unexpected. Lack of snow cover and extreme cold in the winter of 2011 may have been a contributing factor. Mowing in the fall of 2011 may contributed to the loss as well.

The exact origin of the seed harvested in 2012 is not known. Based on accessions removed in 2011, it is known which collections are not included in the harvest.

Future plans are pending.

**Table PJ-1. Collections - Prairie junegrass *Koeleria macrantha*.**

Accession	Collector	Date	State	County	Location	Other
9092070	Knudson, Aune	7/19/06	ND	Ward	SE1/4SW1/4 sec 2, T152N, R84W	
9092071	D. Tober	8/16/06	ND	Oliver	MLRA 54, Arroda Lakes GMA	
9092072	D. Tober	8/16/06	ND	Dunn	1/2 mi. W. of Missouri River State Park Hdqtrs	
9092073	A. Berg	8/4/06	ND	Bowman	sec 22, T130N, R104W	S exp., MLRA 54, cobbart compl.
9092074	D. Teske	7/19/06	ND	Sioux	sec 22, T129N, R83W	Daglum soils
9092075	D. Teske	7/17/06	ND	Sioux	sec 9, T132N, R79W	Prairie Knight Casino entrance
9092076	Anderson, Simonsen	7/11/06	ND	Stutsman	sec 2, T141N, R64W	
9092077	C. Roth	6/27/06	ND	Bottineau	sec 16, T162N, R 75W	
9092078	L. Huether	7/5/06	ND	Mountrail	sec 35, T 92N, R 154W	Fred Evans, native range
9092079	L. Huether	7/5/06	ND	Mountrail	sec 17, T 92N, R 157W	Dustin Roise, lightly grazed
9092080	S. Sieler	7/20/06	ND	McLean	SE1/4 sec 16, T 147N, R 79W	MLRA 53B, state school land
9092081	S. Sieler	7/20/06	ND	McLean	SW1/4 sec 16, T 149N, R 79W	state school land
9092082	W. Duckwitz	7/25/06	ND	Grant	S1/2 sec 14, T 135N, R 88W	Heart Butte Dam, hilltop (2 samples)
9092083	Area 1-Thief River FO	7/20/06	MN	Kittson	Norway Dunes TNC, 4 mi to Halma	north end of unit
9092084	D. Teske	7/12/06	ND	Sioux	N1/2 NW1/4 sec 36, T 131N, R 84W	
9092085	D. Tober, R. Jones	7/21/06	ND	Wells	8 mi N. of Hurdsville, Wells Co. GMA	
9092086	D. Teske	7/12/06	ND	Sioux	SW NE1/4 sec 27, T 130N, R 83 W	
9092087	L. Huether	7/5/06	ND	Mountrail	sec 20, T92N, R154W	
9092088	L. Huether	7/5/06	ND	Mountrail	sec 30, T 92N, R 156W	Curt Trulson land
9092089	L. Huether	7/5/06	ND	Mountrail	sec 21, T 92N, R 159W	Denny Farhart
9092090	W. Duckwitz	6/29/06	ND	Morton	NE1/4 sec 1, T82N, R 140W	north of buildings
9092091	R. Jones	7/25/06	ND	Morton	sec 16, T 139N, R 85W	right behind New Salem Sue
9092092	Forman, Gustafson	7/10/06	ND	Rolette	SE1/4 NW1/4 sec 1, T160N, R 72W	
9092093	D. Teske	7/8/06	ND	Morton	SW SW1/4, sec 14, T138N, R 81W	Teske acreage, Co. Rd. 138
9092094	D. Teske	8/7/06	SD	Corson	sec 13-T20-R27 by EQIP well/tank site	Reeder Loam
9092095	Jensen, Bergsagel	8/9/06	SD	Spink	N1/2 sec 21, T116N, R 65W	Bald Mtn. near Redfield (2 samples)
9092096	D. Teske	7/18/06	SD	Corson	SE1/4 sec 9, T18N, R 21E	Cottonwood Creek
9092097	Jensen, Bergsagel	8/10/06	SD	Deuel	NE1/4 sec 16, T116N, R49W	8 mi N. of Clear Lake along GMA fence
9092098	Jensen, Bergsagel	8/9/06	SD	Faulk	sec 28, 33 T117N, R69W	8 mi south Faulkton
9092099	Jensen, Bergsagel	8/10/06	SD	Codington	sec 13, T119N, R51W	along hwy 20
9092100	Yapp, Schoon	7/12/06	SD	Todd	SE Harrington, 5 mi, 20 mi SW of Rosebud	

Accession	Collector	Date	State	County	Location	Other
9092101	Teske	7/18/06	SD	Corson	SE1/4 sec 8, T18N, R21E	Cottonwood Creek
9092102	Woods, Sommer	7/11/06	SD	Hutchinson	sec 9, T99N, R57W	Harvey Wall-owner
9092103	R. Jones	7/18/06	MN	Ottertail	Inspiration Peak, 12 mi NE of Ashby	
9092104	Rennolet, Woods	7/11/06	SD	Hutchinson	8 mi SE of FO, Dennis Farst, landowner	(2 samples)
9092105	R. Jones	7/17/06	MN	Clay	TNC Bluestem Prairie, 10 mi E. of Moorhead	
9092106	S. Runyan	7/7/06	SD	Hyde	sec 6, T111N, R72W	section line fence
9092107	Jensen, Harding 4-H	7/10/06	SD	Harding	North Cave Hills	
9092108	R. Jasken	summer 06	MN	Becker	sec 18, T142N, R41W	
9092109	Hanson, Bronder	7/14/06	MN	Sherburne	SW1/4 SW1/4 sec 26, T34N, R27W	
9092110	R. Jones	7/18/06	MN	Douglas	TNC Seven Sisters, 3 mi E of Ashby	
9092111	D. Tober	7/24/06	MN	Pope	Ordway Prairie TNC 9 mi se of Brooten, MN	NE of rest stop
9092112	Area 1-Thief River FO	7/20/06	MN	Kittson	Norway Dunes TNC, 4 mi to Halma	south end of unit
9092113	L. Alveshere	7/18/06	ND	McKenzie	NENW sec 15, T152N, R101W	Donald Lindvig
9092114	Blessum, Forman	7/5/06	ND	McHenry	sec 15, T157N, R78W	
9092115	L. Alveshere	8/16/06	ND	McKenzie	NENE sec 16, T149N, R99W	Gene Traustrom
9092116	Jones, Tober	7/20/06	MN		Agassis Dunes TNC 3 mi S. of Fertile	
9092117	L. Alveshere	7/19/06	ND	McKenzie	SWNE sec 25, T149N, R 95W	Arnold Peterson
9092118	L. Alveshere	7/6/06	ND	McKenzie	SESE sec 5, T150N, R96W	Tank Ranch
9092119	L. Alveshere	7/24/06	ND	McKenzie	NESE sec 19, T146N, R103W	John Quinnet, Milt Madison
9092120	Gustafson, Jones	7/20/06	MN		Skull Lake WMA 14 mi N. of Lake Bronson	
9092121	D. Tober	9/26/06	ND	Burleigh	McDowell Dam	from 15 plants
9092123	D. Tober	9/26/06	ND	Stutsman	10 mi N. Medina, WPA, W. side of highway	
9092124	D. Tober	9/12/06	MN	Big Stone	4 mi W. of Beardsley Paradise Retreat Dev.	
9092125	D. Tober	9/26/06	ND	Burleigh	WMA N. of Apple Valley Housing Dev.	
9092126	D. Tober	10/2/06	ND	Grant	across from Crappie Creek, Lake Tschida	
9092133	M. Rose	7/25/06	MN	Renville	sec 21, T113N, R35W Cnty. Rd. 15	native bedrock, MN River
9092134	M. Rose	7/25/06	MN	Redwood Falls	NE1/4 sec 23, T112N, R34W	native pasture (rock outcrops)
9092135	L. Voigt	7/3/06	ND	Dunn	SWNE sec 30-T147-R93,w. saltbox	Andrew Voigt Ranch
9092136		7/24/06	SD	Brown	SW sec 2-T125-R63	1330 ft. elev. Slope2%
9092177	D. Tober	8/31/07	ND	Ransom	Sheyenne National Grasslands, north trail	147th Ave.(co.53) 2 mi N. of Hwy 27
9092178	D. Tober	8/31/07	ND	Ransom	S. of McLeod approx. 1 mi.,Sheyenne Grasslands	west side of gravel road
9092179	D. Tober	8/30/07	MN	Pope	near Ordway Prairie SNA, TNC	W. of Brooten 7 mi.
9092180	D. Tober	8/30/07	MN	Polk	near Agassiz Dunes SNA, TNA	
9092181	D. Tober	8/30/07	MN	Clay	Regional Science Center	4 mi. E. of Glyndon

Accession	Collector	Date	State	County	Location	Other
9092182	D. Tober	9/26/07	WY	Cook	NFS campgrounds, 3 mi NE of Sundance, WY	BHNF trailhead Bearlodge MT.
9092183	D. Tober	9/26/07	WY	Cook	Bearlodge MT. BHNF Cook Lake Rec. Area	1 mi down Cliff Swallow Trail
9092184	D. Tober	9/26/07	WY	Cook	3mi. S. of Beulah, WY Sand Creek Access	
9092185	D. Tober	9/26/07	WY	Cook	Bearlodge MT. BHNF Warren Peak Lookout Tower 6656'	
9092186	D. Tober	9/26/07	WY	Cook	4 mi NW Sundance, BHNF BearLodge Mts.	Reuter Trailhead
9092187	D. Tober	9/28/07	ND	Dunn	1/4 mi S. from maintenance sign to Killdeer Mtns	GMA west side of road
9092188	D. Tober	9/25/07	SD	Meade	summit of Bear Butte E. of Sturgis	N. facing slope
9092189	D. Tober	9/25/07	SD	Meade	2/3 up Bear Butte, E. of Sturgis north facing slope	4200 ft
9092190	D. Tober	9/27/07	ND	Slope	near entrance to Burning Coal Vein, in pines	
9092191	D. Tober	9/27/07	ND	Slope	12 mi W. of Amidon on Burning Coal Vein Rd.	
9092192	D. Tober	9/27/07	ND	Billings	S. of Medora along Little Missouri River bank	
9092193	D. Tober	9/27/07	SD	Harding	Slim Butte Rest Stop, USFS	Hwy 20 W of Reva, SD
9092194	M. Knudson	8/12/07	ND	Slope	sec 25-T134N-R101W	N side of White Butte
9092195	D. Teske	7/12/07	ND	Sioux	sec 26&27-T130-R83	6 mi. W of Selfridge
9092196	C. Dixon	7/1/07	ND		Sully's Hill Native Prairie	
9092197	M. Bellon	7/15/07	ND	Burleigh	sec. 17- T138N-R79W 1mi s. of Lincoln Rd.	1.5 mi E.
9092198	W. Duckwitz	9/6/07	ND	Stark	NE1/4NE1/4sec 16-T141-R91	Rick Schwartz land
9092199	C.Stange, W.Duckwitz	9/6/07	ND	Stark	SW1/4SE1/4 sec 4-T141-R91	Rick Schwartz land
9092200	D. Granbois	8/27/07	SD	Brookings	NE1/4 sec.18-T112N-R47W	Lake Hendricks Township
9092201	J. Dylla, V. DeVine	8/29/07	SD	Clark	sec1-T118-R56	
9092202	Yankton FO	7/1/07	SD	Yankton		
9092203	A. Boltjes	7/19/07	SD	Hyde	sec16-T115N-R73W	
9092204	L. Schoon	8/23/07	SD	Todd	SW1/4 sec10-T38N-R33W	Elk Valley, Inc.
9092205	N. Jensen, D. Tober	7/23/07	SD		Emergency Spillway W. of Oahe Dam	northwest of Pierre, SD
9092206	N. Jensen, D. Tober	7/24/07	SD		Sage Creek Road, SD Badlands	
9092207	L. Schoon	8/15/07	SD	Todd	SW1/2 29-T36N-R25W	Casey Foster Land, sands
9092208	D. Blaha	8/1/07	SD	Sully	sec. 26 T116N-R80W	.5 mi SE of river
9092209	T. Heck	8/1/07	SD	Potter	sec. 28-T117N-R79W	adj to north facing riparian area
9092210	B Woods, T. Sommer	7/13/07	SD	Hutchinson	sec. 31-T99-R58	south of barn
9092211	D.Tober, M. Knudson	10/11/07	MT	Powder River	2 mi. W of Diamond Butte Lookout, W.of Broadus	
9092214	M. Falk	8/24/07	SD	Hand	sec 9-T116-R67	silt loam, 0-2% slope
9092225	Paul Hoversten	9/1/07	MN	Lyon	E1/2 NE1/4 Sec 22 Island Lake Township	



**Table PJ-2. 2010 evaluation data and 2011 selection - Prairie junegrass *Koeleria macrantha***

- \* Height: 1=tall, 3=short
- \*\* Culms: 1=many, 3=few or none
- \*\*\* Leafiness: 1=leafy, 3=few leaves
- \*\*\*\* Maturity: H=heading, A=anthesis, B=boot, V=vegetative, X=no plant

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092070	6	1	6/7/2010	2	1	1	H		
9092070	6	3	6/7/2010	2	1	1	H		
9092070	21	1	6/7/2010	2	1	1	H		
9092070	21	2	6/7/2010	2	3	3	H		
9092070	21	3	6/7/2010	2	1	1	H		
9092070	25	1	6/7/2010	2	1	1	H		
9092070	25	2	6/7/2010	2	2	2	H		
9092070	25	3	6/7/2010	2	1	1	H		
9092071	8	1	6/7/2010	2	2	3	H	thrips	
9092071	8	2	6/7/2010	1	2	2	H	leaf disease	
9092071	8	3	6/7/2010	1	1	1	H	nice plant	
9092071	21	1	6/7/2010	1	2	2	H	thrips	
9092071	21	2	6/7/2010	1	2	2	H		
9092071	21	3	6/7/2010	1	2	2	H		
9092071	26	1	6/7/2010	2	2	2	H		
9092071	26	2	6/7/2010	2	2	2	A		
9092071	26	3	6/7/2010	1	1	1	H		
9092072	4	1	6/7/2010	1	1	2	H		
9092072	4	3	6/7/2010	2	2	2	H		
9092072	21	1	6/7/2010	1	1	1	H		
9092072	21	2	6/7/2010	2	2	3	H		
9092072	21	3	6/7/2010	1	2	2	H		
9092072	23	2	6/7/2010	1	1	1	H		forage
9092072	23	3	6/7/2010	1	1	2	H		
9092073	7	1	6/7/2010	2	2	1	H		
9092073	7	2	6/7/2010	2	2	3	H		
9092073	7	3	6/7/2010	1	1	1	H		
9092073	21	2	6/7/2010	2	2	3	H		
9092073	28	1	6/7/2010	2	2	2	H		
9092073	28	2	6/7/2010	2	1	2	H		
9092073	28	3	6/7/2010	1	1	1	A		
9092075	6	2	6/7/2010	2	2	2	H		
9092075	6	3	6/7/2010	1	1	1	H		
9092075	20	1	6/7/2010	1	2	2	H		
9092075	20	2	6/7/2010	2	1	1	H		
9092075	20	3	6/7/2010	1	2	2	H	Insects	
9092075	22	1	6/7/2010	2	1	2	H		
9092075	22	2	6/7/2010	2	1	2	H		
9092075	22	3	6/7/2010	2	1	2	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092076	8	1	6/7/2010	2	2	3	H		
9092076	8	2	6/7/2010	3	2	3	H		
9092076	8	3	6/7/2010	2	1	2	H		
9092076	20	1	6/7/2010	2	2	2	H		
9092076	20	2	6/7/2010	2	2	3	H		
9092076	20	3	6/7/2010	2	2	2	H		
9092076	23	1	6/7/2010	2	3	3	H		
9092076	23	2	6/7/2010	2	1	2	H	insects	
9092076	23	3	6/7/2010	1	1	2	H	leaf disease	
9092077	2	1	6/7/2010	1	1	2	H	diseased	
9092077	2	2	6/7/2010	1	2	2	H		
9092077	2	3	6/7/2010	3	3	3	H	stressed	
9092077	14	1	6/7/2010	2	1	1	H		
9092077	14	3	6/7/2010	1	1	2	H		
9092077	30	1	6/7/2010	2	1	1	H		
9092077	30	2	6/7/2010	2	2	2	H		
9092077	30	3	6/7/2010	2	2	2	H		
9092078	4	1	6/7/2010	1	1	1	A		
9092078	4	2	6/7/2010	2	1	2	H		
9092078	4	3	6/7/2010	1	1	2	H		turf
9092078	14	1	6/7/2010	2	1	1	H		
9092078	14	2	6/7/2010	2	2	2	H		
9092078	14	3	6/7/2010	2	1	1	H		
9092078	29	1	6/7/2010	1	1	2	H		
9092078	29	2	6/7/2010	1	1	2	H		turf
9092078	29	3	6/7/2010	1	2	2	H		
9092079	6	1	6/7/2010	1	2	2	H		
9092079	6	2	6/7/2010	2	1	2	H		
9092079	13	1	6/7/2010	2	1	3	H	diseased	
9092079	13	2	6/7/2010	1	1	1	H		
9092079	13	3	6/7/2010	2	1	2	H		
9092079	31	1	6/7/2010	2	2	2	A		
9092079	31	2	6/7/2010	1	2	2	H		
9092079	31	3	6/7/2010	2	1	1	H		
9092080	4	1	6/7/2010	1	1	2	H		
9092080	4	2	6/7/2010	2	1	1	H		
9092080	4	3	6/7/2010	3	2	2	H	diseased	
9092080	13	1	6/7/2010	2	2	2	H		
9092080	13	2	6/7/2010	1	2	1	H		turf
9092080	13	3	6/7/2010	2	2	2	A		
9092080	30	3	6/7/2010	2	1	1	H		
9092081	4	1	6/7/2010	3	2	3	H		
9092081	13	1	6/7/2010	2	2	1	H		
9092081	13	2	6/7/2010	2	2	2	H		
9092081	13	3	6/7/2010	2	2	3	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092081	28	1	6/7/2010	2	2	2	H		
9092081	28	2	6/7/2010	2	2	2	H		
9092081	28	3	6/7/2010	2	2	1	H		turf
9092082	2	1	6/7/2010	2	2	3	H	diseased	
9092082	2	2	6/7/2010	3	3	2	H		
9092082	2	3	6/7/2010	1	1	2	H		
9092082	13	1	6/7/2010	1	2	2	H		
9092082	13	3	6/7/2010	1	1	1	H		forage
9092082	26	1	6/7/2010	1	2	2	H		
9092082	26	2	6/7/2010	1	2	1	H		
9092082	26	3	6/7/2010	1	1	1	H		
9092083	1	1	6/7/2010	1	1	2	H		
9092083	1	2	6/7/2010	2	2	2	H		
9092083	1	3	6/7/2010	3	3	3	H		
9092083	13	1	6/7/2010	2	2	2	H		
9092083	13	2	6/7/2010	2	1	2	H		
9092083	13	3	6/7/2010	2	1	2	H		
9092083	28	1	6/7/2010	1	1	2	H		
9092083	28	2	6/7/2010	1	2	1	H		forage
9092083	28	3	6/7/2010	1	2	2	H		
9092084	2	2	6/7/2010	1	1	1	H		forage
9092084	2	3	6/7/2010	2	2	3	H		
9092084	19	1	6/7/2010	1	2	2	H		
9092084	19	2	6/7/2010	2	2	2	H	leaf disease	
9092084	19	3	6/7/2010	2	2	2	H		
9092084	23	1	6/7/2010	1	2	2	H		
9092084	23	2	6/7/2010	3	3	3	H		
9092084	23	3	6/7/2010	1	1	1	H		
9092085	8	1	6/7/2010	2	2	2	H		
9092085	8	2	6/7/2010	2	3	2	H	Insects	
9092085	8	3	6/7/2010	3	3	3	H		
9092085	19	1	6/7/2010	2	2	1	H		
9092085	19	2	6/7/2010	2	1	1	H		forage
9092085	19	3	6/7/2010	2	2	2	H	insects and disease	
9092085	22	1	6/7/2010	2	2	2	H		
9092085	22	2	6/7/2010	2	3	3	H		
9092085	22	3	6/7/2010	2	1	2	H		
9092086	8	1	6/7/2010	2	2	2	H		
9092086	8	2	6/7/2010	2	2	1	H		
9092086	8	3	6/7/2010	2	3	3	H		
9092087	4	1	6/7/2010	2	1	1	H		
9092087	4	2	6/7/2010	2	2	3	H		
9092087	4	3	6/7/2010	1	2	1	H		
9092087	19	1	6/7/2010	2	2	2	H		
9092087	19	2	6/7/2010	2	2	2	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092087	19	3	6/7/2010	2	1	1	H		
9092087	22	1	6/7/2010	2	2	2	H		
9092087	22	2	6/7/2010	3	3	2	H		
9092087	22	3	6/7/2010	3	3	3	H		
9092088	7	1	6/7/2010	1	2	3	H		
9092088	19	1	6/7/2010	1	1	1	H		
9092088	19	2	6/7/2010	2	2	1	H		
9092088	19	3	6/7/2010	2	2	2	H		
9092088	21	1	6/7/2010	2	2	2	H		
9092088	21	2	6/7/2010	2	1	1	H	bluegrass contaminant	
9092088	21	3	6/7/2010	2	2	2	H		
9092089	6	1	6/7/2010	3	3	3	H		
9092089	6	2	6/7/2010	3	3	3	H		
9092089	6	3	6/7/2010	3	1	2	H		turf
9092089	18	1	6/7/2010	2	1	1	H		
9092089	18	2	6/7/2010	3	3	3	H		
9092089	18	3	6/7/2010	2	2	2	H		
9092089	24	1	6/7/2010	2	1	2	H		
9092089	24	2	6/7/2010	1	1	1	H		turf
9092089	24	3	6/7/2010	2	1	1	H		
9092090	7	1	6/7/2010	2	2	1	H		
9092090	7	2	6/7/2010	1	1	1	H		forage
9092090	7	3	6/7/2010	1	1	1	H		
9092090	18	1	6/7/2010	2	1	2	H		
9092090	18	2	6/7/2010	1	1	2	H		
9092090	18	3	6/7/2010	2	2	2	H		
9092090	25	1	6/7/2010	2	1	2	H		
9092090	25	2	6/7/2010	2	1	1	H		
9092090	25	3	6/7/2010	2	1	2	H		
9092091	3	1	6/7/2010	1	1	1	H	upright	
9092091	3	2	6/7/2010	2	2	2	H		
9092091	3	3	6/7/2010	2	1	2	H		
9092091	17	1	6/7/2010	1	1	2	H	diseased	
9092091	17	2	6/7/2010	3	3	2	V		
9092091	17	3	6/7/2010	3	2	2	H		
9092091	27	1	6/7/2010	1	1	1	H		
9092091	27	2	6/7/2010	2	1	2	H		turf
9092091	27	3	6/7/2010	1	1	1	H		
9092092	6	1	6/7/2010	2	3	3	H		
9092092	6	2	6/7/2010	2	1	2	H		
9092092	6	3	6/7/2010	2	3	2	H		
9092092	17	1	6/7/2010	2	2	1	H	leafy turf type	turf
9092092	17	3	6/7/2010	1	1	2	H		
9092092	31	1	6/7/2010	0	0	0	X		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092092	31	3	6/7/2010	0	0	0	X		
9092093	3	1	6/7/2010	1	2	3	H		
9092093	3	2	6/7/2010	2	2	3	H		
9092093	3	3	6/7/2010	1	1	2	H		
9092093	17	1	6/7/2010	1	2	2	H		forage
9092093	17	2	6/7/2010	2	2	2	H		
9092093	17	3	6/7/2010	2	2	2	H		
9092093	29	1	6/7/2010	2	2	2	H		
9092093	29	2	6/7/2010	2	1	1	H		
9092093	29	3	6/7/2010	1	1	2	H		
9092095	6	1	6/7/2010	1	2	2	H		
9092095	6	2	6/7/2010	2	2	2	H		
9092095	17	1	6/7/2010	2	2	2	H		
9092095	17	2	6/7/2010	2	3	2	H		
9092095	17	3	6/7/2010	2	2	3	H		
9092095	31	1	6/7/2010	1	2	1	H		
9092095	31	2	6/7/2010	3	3	2	H		
9092095	31	3	6/7/2010	2	3	3	H		
9092097	5	1	6/7/2010	3	1	2	H		
9092097	17	1	6/7/2010	2	2	2	H		
9092097	17	2	6/7/2010	2	1	2	H		
9092097	17	3	6/7/2010	2	2	2	H		
9092097	27	1	6/7/2010	2	1	2	H		
9092097	27	2	6/7/2010	2	2	2	H		
9092097	27	3	6/7/2010	2	2	2	H		
9092098	8	1	6/7/2010	2	2	2	H		
9092098	8	2	6/7/2010	2	1	1	H		
9092098	8	3	6/7/2010	3	2	3	H		
9092098	14	1	6/7/2010	2	2	2	H		
9092098	14	2	6/7/2010	3	2	2	H		
9092098	14	3	6/7/2010	3	2	2	H		
9092098	26	1	6/7/2010	2	1	1	H		
9092098	26	2	6/7/2010	2	2	2	H		
9092098	26	3	6/7/2010	2	1	1	H		
9092099	5	1	6/7/2010	2	2	3	H		
9092099	5	2	6/7/2010	3	3	3	H		
9092099	5	3	6/7/2010	2	3	3	H		
9092099	14	1	6/7/2010	2	2	3	H		
9092099	14	2	6/7/2010	2	2	2	H		
9092099	14	3	6/7/2010	2	2	2	H		
9092099	24	1	6/7/2010	2	1	2	H		
9092099	24	2	6/7/2010	2	1	1	H		
9092099	24	3	6/7/2010	2	2	2	H		
9092100	7	1	6/7/2010	2	3	3	H		
9092100	7	2	6/7/2010	2	2	2	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092100	7	3	6/7/2010	0	0	0	X		
9092100	14	1	6/7/2010	2	2	2	H		
9092100	14	2	6/7/2010	2	2	2	H		
9092100	14	3	6/7/2010	2	2	2	H		
9092100	22	1	6/7/2010	2	1	1	H		
9092100	22	2	6/7/2010	2	1	1	H		
9092100	22	3	6/7/2010	2	2	2	H		
9092101	1	2	6/7/2010	1	2	2	H		
9092101	1	3	6/7/2010	2	2	1	H		
9092101	14	1	6/7/2010	1	1	1	H		
9092101	14	2	6/7/2010	2	2	1	H		
9092101	14	3	6/7/2010	2	2	1	H		
9092101	27	1	6/7/2010	1	1	2	H		
9092101	27	2	6/7/2010	1	2	2	H		
9092101	27	3	6/7/2010	1	1	2	H		
9092102	1	1	6/7/2010	2	2	2	H	some disease	
9092102	1	2	6/7/2010	3	3	3	H		
9092102	14	1	6/7/2010	2	2	2	H		
9092102	14	2	6/7/2010	2	3	1	V	veg, no heads	
9092102	14	3	6/7/2010	2	2	2	B		
9092102	29	1	6/7/2010	1	1	1	H		
9092102	29	2	6/7/2010	1	1	1	H		forage
9092102	29	3	6/7/2010	2	2	1	H		turf
9092103	3	1	6/7/2010	2	2	3	H		
9092103	3	2	6/7/2010	1	1	2	H		
9092103	3	3	6/7/2010	2	2	3	H		
9092103	15	1	6/7/2010	1	1	2	H		
9092103	15	2	6/7/2010	2	2	2	H		
9092103	15	3	6/7/2010	2	1	2	H	diseased	
9092103	27	1	6/7/2010	1	1	2	H		
9092103	27	2	6/7/2010	1	1	1	H		
9092103	27	3	6/7/2010	1	2	2	H		
9092104	5	1	6/7/2010	1	2	2	H		
9092104	5	3	6/7/2010	2	2	1	H		
9092104	15	1	6/7/2010	2	2	1	H		
9092104	15	2	6/7/2010	2	1	1	H		
9092104	15	3	6/7/2010	2	2	1	H		
9092104	29	1	6/7/2010	2	1	2	H		
9092104	29	2	6/7/2010	1	1	1	H		forage
9092104	29	3	6/7/2010	1	1	1	H		
9092105	3	2	6/7/2010	3	3	3	H		
9092105	3	3	6/7/2010	2	1	2	H		
9092105	16	1	6/7/2010	2	2	2	H		
9092105	16	2	6/7/2010	2	2	2	H		
9092105	16	3	6/7/2010	2	2	2	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092105	25	1	6/7/2010	1	2	2	H		
9092105	25	2	6/7/2010	1	2	2	H		
9092105	25	3	6/7/2010	1	1	2	H		
9092106	3	1	6/7/2010	2	3	3	H		
9092106	3	3	6/7/2010	2	2	2	H		
9092106	16	1	6/7/2010	2	2	2	H		
9092106	16	2	6/7/2010	2	2	2	H		
9092106	16	3	6/7/2010	2	2	2	H		
9092106	23	1	6/7/2010	2	1	2	H		
9092106	23	2	6/7/2010	2	3	3	H		
9092106	23	3	6/7/2010	2	2	2	H		
9092107	5	1	6/7/2010	1	1	2	H		
9092107	5	2	6/7/2010	1	2	2	H		
9092107	5	3	6/7/2010	1	1	1	H	diseased	
9092107	16	1	6/7/2010	2	2	2	H		
9092107	16	2	6/7/2010	2	2	1	H		
9092107	16	3	6/7/2010	2	2	2	H		
9092107	28	1	6/7/2010	1	2	1	H		
9092107	28	3	6/7/2010	2	1	2	H		
9092108	5	1	6/7/2010	1	2	2	H		
9092108	5	2	6/7/2010	1	1	2	H		
9092108	5	3	6/7/2010	1	1	1	H		turf
9092108	16	1	6/7/2010	2	2	2	H		
9092108	16	2	6/7/2010	2	1	2	H		
9092108	25	1	6/7/2010	1	1	2	H		
9092108	25	2	6/7/2010	1	2	2	H		
9092108	25	3	6/7/2010	2	2	2	H		
9092109	5	1	6/7/2010	1	2	2	H		forage
9092109	5	2	6/7/2010	2	2	2	H	insects	
9092109	5	3	6/7/2010	1	2	2	H		
9092109	16	1	6/7/2010	1	2	1	H		
9092109	16	2	6/7/2010	1	1	2	H		
9092109	16	3	6/7/2010	2	1	1	H		
9092109	27	1	6/7/2010	1	1	1	H		forage
9092109	27	2	6/7/2010	1	1	2	H		
9092109	27	3	6/7/2010	1	1	2	H		
9092110	5	1	6/7/2010	2	3	3	H	partially dead	
9092110	5	2	6/7/2010	2	2	2	H		
9092110	5	3	6/7/2010	0	0	0	X		
9092110	17	1	6/7/2010	2	2	2	H		
9092110	17	2	6/7/2010	1	1	2	H		
9092110	17	3	6/7/2010	1	1	2	H		
9092110	30	2	6/7/2010	2	2	3	H		
9092110	30	3	6/7/2010	2	1	2	H		
9092111	2	1	6/7/2010	1	3	3	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092111	2	3	6/7/2010	2	1	1	H	diseased	
9092111	17	1	6/7/2010	2	2	3	H		
9092111	17	2	6/7/2010	2	1	1	H	Insects	
9092111	17	3	6/7/2010	2	2	3	H		
9092111	30	1	6/7/2010	2	2	2	H		
9092111	30	2	6/7/2010	1	2	2	H		
9092111	30	3	6/7/2010	1	1	2	H		
9092112	7	2	6/7/2010	2	3	3	H		
9092112	19	1	6/7/2010	2	2	3	H		
9092112	19	2	6/7/2010	2	2	2	H		
9092112	19	3	6/7/2010	2	2	2	H		
9092112	22	1	6/7/2010	1	1	2	H		
9092112	22	2	6/7/2010	3	3	3	H	partially dead	
9092113	10	1	6/7/2010	2	2	2	H		
9092113	10	2	6/7/2010	2	1	1	A		
9092113	10	3	6/7/2010	3	3	3	A		
9092113	19	1	6/7/2010	2	2	2	H		
9092113	19	2	6/7/2010	2	2	2	H		
9092113	29	1	6/7/2010	1	1	1	H		
9092113	29	2	6/7/2010	1	1	1	H		
9092114	10	1	6/7/2010	2	3	2	H		
9092114	10	3	6/7/2010	2	1	1	H		forage
9092114	18	1	6/7/2010	1	1	2	H		
9092114	18	2	6/7/2010	2	2	2	H		
9092114	18	3	6/7/2010	2	1	1	H		forage
9092114	31	1	6/7/2010	1	1	1	H		
9092114	31	2	6/7/2010	1	1	2	H		
9092114	31	3	6/7/2010	1	1	1	H		
9092115	10	1	6/7/2010	2	2	2	H		
9092115	10	2	6/7/2010	2	1	2	H		
9092115	10	3	6/7/2010	2	1	2	H		
9092115	18	1	6/7/2010	1	2	2	H		
9092115	18	3	6/7/2010	2	3	3	H		
9092115	30	1	6/7/2010	2	2	2	H		
9092115	30	2	6/7/2010	1	1	1	H		
9092115	30	3	6/7/2010	2	1	1	H		
9092116	10	1	6/7/2010	1	1	1	H		
9092116	10	2	6/7/2010	1	1	2	H		
9092116	10	3	6/7/2010	2	2	2	H		
9092116	20	1	6/7/2010	1	2	1	H	turf type	
9092116	20	2	6/7/2010	2	1	1	H		
9092116	20	3	6/7/2010	2	1	1	H		
9092116	27	3	6/7/2010	1	1	3	H		
9092117	10	1	6/7/2010	1	1	2	H		
9092117	10	2	6/7/2010	2	2	2	H	diseased	

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092117	10	3	6/7/2010	2	2	2	H		
9092117	20	1	6/7/2010	2	2	2	H		
9092117	20	3	6/7/2010	1	2	2	H		
9092117	24	1	6/7/2010	2	2	2	H		
9092117	24	2	6/7/2010	1	1	2	H		
9092117	24	3	6/7/2010	3	2	2	H		
9092118	9	1	6/7/2010	2	3	3	H		
9092118	9	2	6/7/2010	2	1	1	H		turf
9092118	9	3	6/7/2010	1	2	2	H		
9092118	20	1	6/7/2010	1	1	2	H		forage
9092118	20	2	6/7/2010	1	2	1	H		
9092118	20	3	6/7/2010	2	3	2	H		
9092118	26	1	6/7/2010	1	2	2	H		
9092118	26	2	6/7/2010	1	1	1	H		
9092118	26	3	6/7/2010	2	2	2	H		
9092119	6	2	6/7/2010	2	1	2	H		
9092119	6	3	6/7/2010	2	2	2	H		
9092119	19	1	6/7/2010	2	2	2	H		
9092119	19	2	6/7/2010	1	2	1	H		
9092119	19	3	6/7/2010	1	1	2	H		
9092119	24	1	6/7/2010	1	1	1	H		
9092119	24	2	6/7/2010	1	2	2	H		
9092119	24	3	6/7/2010	1	1	1	H		
9092120	4	1	6/7/2010	2	2	2	H		
9092120	4	2	6/7/2010	2	2	2	H		
9092120	4	3	6/7/2010	2	3	3	H		
9092120	19	1	6/7/2010	2	1	2	H		
9092120	19	2	6/7/2010	2	1	1	H		
9092120	19	3	6/7/2010	2	2	3	H	diseased	
9092120	26	1	6/7/2010	3	3	2	H		
9092120	26	2	6/7/2010	1	1	2	H		
9092120	26	3	6/7/2010	2	1	2	H		
9092121	19	1	6/7/2010	2	2	1	H		forage
9092121	19	2	6/7/2010	2	2	2	H		
9092121	19	3	6/7/2010	2	2	2	H	Insects	
9092121	23	1	6/7/2010	2	3	3	H		
9092121	23	2	6/7/2010	2	2	3	H		
9092121	23	3	6/7/2010	2	3	3	H		
9092123	11	1	6/7/2010	2	2	2	H		
9092123	11	2	6/7/2010	2	2	2	H		
9092123	11	3	6/7/2010	2	2	2	H		
9092123	15	1	6/7/2010	2	2	2	H		turf
9092124	7	1	6/7/2010	2	2	3	H		
9092124	7	3	6/7/2010	2	3	3	H		
9092124	15	1	6/7/2010	1	2	2	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092124	15	2	6/7/2010	1	2	2	H		
9092124	15	3	6/7/2010	2	2	2	H		
9092124	31	2	6/7/2010	2	3	3	H		
9092124	31	3	6/7/2010	1	1	2	H		
9092125	5	1	6/7/2010	1	2	2	H		
9092125	5	2	6/7/2010	1	2	1	H		
9092125	5	3	6/7/2010	1	1	1	H		
9092125	15	1	6/7/2010	3	2	3	H		
9092125	15	2	6/7/2010	1	2	2	H		
9092125	15	3	6/7/2010	3	3	3	H		
9092125	31	1	6/7/2010	1	2	3	H		
9092125	31	2	6/7/2010	2	2	1	H		
9092125	31	3	6/7/2010	2	2	2	H		
9092126	3	1	6/7/2010	2	1	2	H		
9092126	3	2	6/7/2010	3	3	3	H		
9092126	15	1	6/7/2010	2	2	1	H		
9092126	15	3	6/7/2010	2	2	2	H		
9092126	30	1	6/7/2010	2	1	2	H		
9092126	30	2	6/7/2010	2	2	2	H		
9092126	30	3	6/7/2010	1	1	2	H		
9092133	1	1	6/7/2010	3	3	3	H	almost dead	
9092133	1	3	6/7/2010	2	2	2	H		
9092133	11	1	6/7/2010	2	1	1	H		
9092133	11	2	6/7/2010	1	1	1	H	nice plant	turf
9092133	11	3	6/7/2010	2	2	1	H		turf
9092133	25	1	6/7/2010	2	1	3	H		
9092134	1	2	6/7/2010	3	3	3	H		
9092134	11	1	6/7/2010	2	3	3	H		
9092134	11	2	6/7/2010	0	0	0	X		
9092134	11	3	6/7/2010	3	2	2	H		
9092134	23	1	6/7/2010	1	2	2	H		
9092135	1	2	6/7/2010	1	1	1	H		turf
9092135	1	3	6/7/2010	1	2	2	H		
9092135	11	2	6/7/2010	1	1	1	H	partially dead	
9092135	11	3	6/7/2010	2	1	2	H		
9092135	28	1	6/7/2010	1	1	1	H		
9092135	28	2	6/7/2010	1	2	2	H		
9092136	1	1	6/7/2010	2	3	2	H		
9092136	1	3	6/7/2010	2	3	3	H		
9092136	12	1	6/7/2010	2	2	2	H		
9092136	12	2	6/7/2010	2	1	2	H		
9092136	12	3	6/7/2010	3	3	3	H	almost dead	
9092136	22	1	6/7/2010	2	2	2	H		
9092136	22	2	6/7/2010	3	3	2	H		
9092136	22	3	6/7/2010	3	2	2	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092177	9	1	6/7/2010	2	2	2	H		
9092177	9	2	6/7/2010	1	2	2	H		
9092177	9	3	6/7/2010	2	2	2	H		
9092177	12	1	6/7/2010	1	1	1	H		
9092177	12	2	6/7/2010	1	2	1	H		forage
9092177	12	3	6/7/2010	2	2	2	H		
9092177	24	1	6/7/2010	1	2	2	H		forage
9092177	24	2	6/7/2010	2	3	3	H		
9092177	24	3	6/7/2010	1	1	1	H		
9092178	9	1	6/7/2010	2	2	1	H		
9092178	9	2	6/7/2010	2	2	2	H		
9092178	9	3	6/7/2010	2	2	2	H	thrips	
9092178	11	1	6/7/2010	1	2	2	H		
9092178	11	2	6/7/2010	1	2	2	H		
9092178	11	3	6/7/2010	2	2	2	H		
9092178	28	1	6/7/2010	1	1	2	H		
9092178	28	2	6/7/2010	1	2	2	H		
9092178	28	3	6/7/2010	1	2	2	H		
9092179	10	1	6/7/2010	2	2	2	H		
9092179	10	2	6/7/2010	2	2	2	H	diseased	
9092179	10	3	6/7/2010	2	2	3	H	diseased	
9092179	12	1	6/7/2010	2	1	2	H		
9092179	12	2	6/7/2010	2	1	1	H	diseased	
9092179	29	1	6/7/2010	1	1	1	H		
9092179	29	2	6/7/2010	1	2	2	H		
9092179	29	3	6/7/2010	2	2	2	H		
9092180	3	2	6/7/2010	2	2	2	H		
9092180	3	3	6/7/2010	3	3	3	H		
9092180	16	1	6/7/2010	2	2	2	H		
9092180	16	2	6/7/2010	1	1	1	H		forage
9092180	16	3	6/7/2010	2	3	3	H		
9092180	27	1	6/7/2010	2	2	2	H		
9092180	27	2	6/7/2010	2	2	3	H		
9092180	27	3	6/7/2010	3	3	3	H		
9092181	8	1	6/7/2010	3	3	3	H		
9092181	8	2	6/7/2010	1	1	2	H	nice plant	
9092181	8	3	6/7/2010	2	2	2	H		
9092181	16	1	6/7/2010	3	2	3	H		
9092181	16	2	6/7/2010	1	1	2	H		
9092181	16	3	6/7/2010	2	2	3	H		
9092181	31	1	6/7/2010	1	1	2	H		
9092182	2	1	6/7/2010	1	2	2	A		
9092182	16	1	6/7/2010	1	1	1	H	nice plant	
9092182	16	3	6/7/2010	1	1	1	H		
9092182	22	1	6/7/2010	1	1	2	A		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092182	22	2	6/7/2010	1	1	1	A		
9092182	22	3	6/7/2010	1	1	1	A		
9092183	4	1	6/7/2010	3	2	2	A		turf
9092183	4	3	6/7/2010	2	2	3	A		
9092183	20	1	6/7/2010	1	1	2	H	Insects	
9092183	20	2	6/7/2010	2	2	2	H		
9092183	31	1	6/7/2010	2	2	2	H		
9092183	31	2	6/7/2010	1	1	2	A		
9092184	7	1	6/7/2010	1	1	1	H		
9092184	7	3	6/7/2010	1	1	1	A		
9092184	20	2	6/7/2010	1	2	1	A		
9092184	20	3	6/7/2010	1	2	2	H		
9092184	28	2	6/7/2010	1	1	2	A		
9092185	6	1	6/7/2010	2	1	2	H		
9092185	6	2	6/7/2010	1	1	2	H		
9092185	6	3	6/7/2010	3	2	2	H		
9092185	20	1	6/7/2010	3	2	1	H		
9092185	20	2	6/7/2010	2	1	2	H	Insects	
9092185	20	3	6/7/2010	3	3	2	A		
9092185	28	1	6/7/2010	2	2	2	A		
9092185	28	2	6/7/2010	1	1	1	A		
9092185	28	3	6/7/2010	1	2	2	A		
9092186	9	3	6/7/2010	1	1	1	H	thrips	
9092186	20	1	6/7/2010	1	3	3	H		
9092186	20	3	6/7/2010	1	1	1	H		
9092186	22	1	6/7/2010	1	1	2	H		
9092186	22	2	6/7/2010	1	1	1	H		
9092186	22	3	6/7/2010	1	1	1	H		
9092187	8	1	6/7/2010	2	1	2	H		
9092187	8	2	6/7/2010	2	1	1	H		
9092187	8	3	6/7/2010	2	1	1	H	thrips	
9092187	18	1	6/7/2010	2	2	2	H		
9092187	18	2	6/7/2010	2	2	2	H		
9092187	18	3	6/7/2010	1	1	2	H		forage
9092187	25	1	6/7/2010	1	1	1	H		
9092187	25	2	6/7/2010	1	1	2	H		
9092187	25	3	6/7/2010	2	2	2	H		
9092188	8	1	6/7/2010	2	1	1	H		
9092188	8	3	6/7/2010	2	1	1	H	fine heads	
9092188	18	1	6/7/2010	2	1	1	B		
9092188	18	2	6/7/2010	3	1	2	H		
9092188	18	3	6/7/2010	2	2	3	H		
9092188	26	1	6/7/2010	3	2	1	H		
9092189	18	1	6/7/2010	3	1	1	H		turf
9092189	18	2	6/7/2010	3	2	2	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092189	18	3	6/7/2010	2	2	1	H		
9092189	25	1	6/7/2010	2	2	2	H		
9092189	25	2	6/7/2010	2	2	2	H		
9092189	25	3	6/7/2010	3	3	3	H		
9092190	4	1	6/7/2010	2	3	3	H		
9092190	4	2	6/7/2010	3	3	3	A		
9092190	18	1	6/7/2010	1	2	2	H		
9092190	18	2	6/7/2010	2	2	2	H		
9092190	18	3	6/7/2010	2	2	3	H		
9092190	21	1	6/7/2010	2	1	1	H		
9092190	21	2	6/7/2010	3	2	3	H	Insects	
9092190	21	3	6/7/2010	2	2	3	H		
9092191	1	1	6/7/2010	1	3	3	A		
9092191	1	2	6/7/2010	1	1	2	H		
9092191	18	1	6/7/2010	1	2	2	H		
9092191	18	2	6/7/2010	1	2	2	H		
9092191	18	3	6/7/2010	1	2	1	H		
9092191	24	1	6/7/2010	1	2	2	A		
9092191	24	2	6/7/2010	2	2	2	H		
9092191	24	3	6/7/2010	2	1	2	H		
9092192	3	1	6/7/2010	1	2	2	H		
9092192	17	1	6/7/2010	2	2	3	H		
9092192	17	2	6/7/2010	2	2	3	H		
9092192	17	3	6/7/2010	2	1	1	H		
9092192	30	1	6/7/2010	1	1	1	H		forage
9092192	30	2	6/7/2010	2	2	2	H		
9092192	30	3	6/7/2010	1	1	1	H		
9092193	2	3	6/7/2010	1	2	2	H		
9092193	17	1	6/7/2010	3	2	2	H		
9092193	17	2	6/7/2010	3	2	2	H	Insects	
9092193	17	3	6/7/2010	2	2	2	H		
9092193	29	1	6/7/2010	1	2	1	H		
9092193	29	2	6/7/2010	2	1	1	H		
9092193	29	3	6/7/2010	2	1	2	H		
9092194	5	1	6/7/2010	2	1	2	H		
9092194	5	2	6/7/2010	2	2	1	H		
9092194	5	3	6/7/2010	2	2	3	H		
9092194	16	1	6/7/2010	3	2	2	H		
9092194	16	2	6/7/2010	3	2	1	H		
9092194	16	3	6/7/2010	1	1	1	H		
9092194	25	1	6/7/2010	1	1	1	H		turf
9092194	25	2	6/7/2010	1	1	1	H		forage
9092194	25	3	6/7/2010	2	1	1	H		
9092195	6	1	6/7/2010	1	2	2	H		
9092195	6	2	6/7/2010	3	3	3	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092195	6	3	6/7/2010	2	1	1	H	upright, nice plant	
9092195	15	1	6/7/2010	1	1	1	H	thrips	forage
9092195	15	2	6/7/2010	3	2	2	H		
9092195	15	3	6/7/2010	2	2	2	H		
9092195	22	1	6/7/2010	2	1	1	H		
9092195	22	2	6/7/2010	1	2	1	H	very leafy	
9092195	22	3	6/7/2010	2	1	1	H		
9092196	7	1	6/7/2010	1	2	2	H		
9092196	7	2	6/7/2010	3	3	2	H		
9092196	7	3	6/7/2010	2	2	1	H		
9092196	15	1	6/7/2010	2	2	2	H		turf
9092196	15	2	6/7/2010	2	1	2	H		
9092196	15	3	6/7/2010	2	2	2	H		
9092196	30	1	6/7/2010	2	2	2	H		
9092196	30	2	6/7/2010	2	1	1	H		
9092196	30	3	6/7/2010	1	1	2	H		
9092197	8	1	6/7/2010	2	3	3	H		
9092197	8	3	6/7/2010	1	1	1	H		forage
9092197	15	1	6/7/2010	2	2	1	H		
9092197	15	2	6/7/2010	2	1	1	H		
9092197	15	3	6/7/2010	2	1	2	H		
9092197	24	1	6/7/2010	1	1	2	H		
9092197	24	2	6/7/2010	2	2	2	H		
9092197	24	3	6/7/2010	1	1	1	H		
9092198	9	1	6/7/2010	2	2	2	H		
9092198	9	2	6/7/2010	1	2	2	H		
9092198	21	1	6/7/2010	2	2	2	H		
9092198	21	2	6/7/2010	2	2	3	H		
9092198	21	3	6/7/2010	2	1	1	H		
9092198	28	1	6/7/2010	2	2	1	H		
9092198	28	2	6/7/2010	2	2	1	H		
9092198	28	3	6/7/2010	2	2	2	H		
9092199	9	1	6/7/2010	1	1	1	H		forage
9092199	9	2	6/7/2010	1	1	1	H		turf
9092199	9	3	6/7/2010	2	1	1	H		
9092199	21	1	6/7/2010	1	2	1	H	Insects	
9092199	21	2	6/7/2010	2	2	2	H		
9092199	23	1	6/7/2010	3	3	2	H		
9092199	23	2	6/7/2010	2	1	2	H		
9092199	23	3	6/7/2010	1	1	2	H		
9092200	9	1	6/7/2010	2	2	2	H		
9092200	9	2	6/7/2010	3	3	3	H		
9092200	9	3	6/7/2010	1	2	2	H		
9092200	21	1	6/7/2010	2	1	2	H		turf
9092200	21	2	6/7/2010	2	2	1	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092200	21	3	6/7/2010	2	2	2	H		
9092200	26	1	6/7/2010	1	1	1	H		forage
9092200	26	2	6/7/2010	2	1	2	H		
9092200	26	3	6/7/2010	2	2	1	H		
9092201	10	1	6/7/2010	3	1	2	H		
9092201	10	2	6/7/2010	2	2	2	H		
9092201	10	3	6/7/2010	3	1	1	H	turf type	turf
9092201	12	1	6/7/2010	2	2	3	H		
9092201	12	2	6/7/2010	2	1	1	H		
9092201	12	3	6/7/2010	2	1	1	H	turf type	turf
9092201	26	1	6/7/2010	2	2	2	H		
9092201	26	2	6/7/2010	1	1	1	H		
9092202	11	1	6/7/2010	1	2	1	H		
9092202	11	2	6/7/2010	2	3	3	H	Insects	
9092202	11	3	6/7/2010	2	1	2	H	diseased	
9092202	12	1	6/7/2010	1	1	2	H		
9092202	12	2	6/7/2010	1	2	2	H		
9092202	12	3	6/7/2010	1	2	3	H		
9092202	27	1	6/7/2010	2	2	2	H		
9092202	27	2	6/7/2010	2	2	2	H		
9092202	27	3	6/7/2010	2	1	1	H		
9092203	11	1	6/7/2010	2	2	3	H		
9092203	11	2	6/7/2010	1	2	2	H	Insects	
9092203	11	3	6/7/2010	2	2	2	H		
9092203	12	1	6/7/2010	2	2	2	H		
9092203	12	2	6/7/2010	3	3	3	H	almost dead	
9092203	12	3	6/7/2010	1	2	2	H		
9092203	30	1	6/7/2010	1	1	1	H		
9092203	30	2	6/7/2010	2	1	1	H		
9092203	30	3	6/7/2010	2	1	2	H		
9092204	11	1	6/7/2010	2	1	1	H		
9092204	11	2	6/7/2010	2	2	2	H		
9092204	11	3	6/7/2010	2	1	1	H		
9092204	12	2	6/7/2010	2	3	2	H		
9092204	12	3	6/7/2010	2	1	1	H		forage
9092204	31	1	6/7/2010	2	2	2	H		
9092205	10	1	6/7/2010	2	2	1	H		
9092205	10	2	6/7/2010	2	1	1	H		
9092205	10	3	6/7/2010	2	2	2	H		
9092205	12	1	6/7/2010	2	2	3	H		
9092205	12	2	6/7/2010	1	2	1	H		
9092205	12	3	6/7/2010	1	1	1	H	turf type	
9092205	23	1	6/7/2010	1	1	1	H		
9092205	23	3	6/7/2010	1	1	1	H		
9092206	10	1	6/7/2010	2	2	2	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092206	10	2	6/7/2010	1	1	1	H	upright	
9092206	10	3	6/7/2010	2	2	1	H		
9092206	12	1	6/7/2010	2	2	2	H	Insects	
9092206	12	2	6/7/2010	1	2	1	H		
9092206	12	3	6/7/2010	2	1	1	H	Insects	
9092206	27	1	6/7/2010	3	3	3	V		
9092206	27	2	6/7/2010	2	2	2	A		
9092206	27	3	6/7/2010	3	3	3	H		
9092207	7	1	6/7/2010	2	3	3	H		
9092207	7	2	6/7/2010	1	1	2	A		
9092207	7	3	6/7/2010	2	2	2	H		
9092207	13	1	6/7/2010	1	2	2	H		
9092207	13	2	6/7/2010	2	1	2	H		
9092207	13	3	6/7/2010	2	2	2	H		
9092207	29	1	6/7/2010	2	2	2	H		
9092207	29	2	6/7/2010	1	2	2	H		
9092207	29	3	6/7/2010	2	2	2	H		
9092208	4	1	6/7/2010	2	2	2	H		
9092208	4	2	6/7/2010	2	2	1	B		
9092208	13	1	6/7/2010	2	2	2	H		
9092208	13	2	6/7/2010	1	2	2	H		
9092208	13	3	6/7/2010	2	1	1	H		
9092208	24	1	6/7/2010	2	2	3	H		
9092208	24	2	6/7/2010	2	2	1	H		
9092208	24	3	6/7/2010	2	2	1	H		
9092209	2	1	6/7/2010	2	2	1	H		
9092209	2	2	6/7/2010	2	3	3	H		
9092209	2	3	6/7/2010	2	1	2	H	diseased	
9092209	13	1	6/7/2010	2	2	1	H		
9092209	13	2	6/7/2010	2	2	2	H		
9092209	13	3	6/7/2010	1	1	1	H		
9092209	26	1	6/7/2010	2	2	1	H		
9092209	26	2	6/7/2010	1	2	2	H		
9092210	1	1	6/7/2010	2	3	3	H		
9092210	1	2	6/7/2010	1	1	2	H	upright	
9092210	1	3	6/7/2010	3	2	2	H		
9092210	13	2	6/7/2010	2	3	2	H	leaf disease	
9092210	13	3	6/7/2010	3	2	1	H	Insects	
9092210	29	1	6/7/2010	2	2	3	H		
9092210	29	2	6/7/2010	2	1	2	H		
9092211	9	1	6/7/2010	1	2	2	A		
9092211	9	3	6/7/2010	1	1	1	A		
9092211	14	1	6/7/2010	2	1	2	A		
9092211	14	2	6/7/2010	1	2	2	A		
9092211	23	1	6/7/2010	3	2	2	A		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092211	23	2	6/7/2010	1	1	2	A		
9092211	23	3	6/7/2010	1	1	1	A		
9092214	3	1	6/7/2010	3	3	3	H		
9092214	3	2	6/7/2010	2	2	2	H		
9092214	3	3	6/7/2010	1	1	1	H		
9092214	11	1	6/7/2010	0	0	0	X		
9092214	11	2	6/7/2010	2	2	3	H		
9092214	11	3	6/7/2010	3	2	2	H		
9092214	24	1	6/7/2010	1	1	1	H		
9092214	24	2	6/7/2010	2	1	2	H		
9092214	24	3	6/7/2010	1	2	2	H		
9092225	9	1	6/7/2010	2	2	2	H		
9092225	9	2	6/7/2010	2	2	2	H		
9092225	9	3	6/7/2010	3	3	3	H		
9092225	14	1	6/7/2010	3	1	2	H		
9092225	14	2	6/7/2010	2	1	1	H		turf
9092225	14	3	6/7/2010	2	2	2	H		
9092225	25	1	6/7/2010	2	2	2	H		
9092225	25	2	6/7/2010	2	1	1	H		
9092225	25	3	6/7/2010	1	2	1	H		turf

## **ACTIVE STUDIES: TECHNICAL REPORT 2013**

### **Study NDPMC-P-0601-RA**

**Study Title:** Native Forbs/Legumes for Conservation  
Fourwing saltbush *Atriplex canescens*

**Introduction:** Fourwing saltbush is a perennial shrub that offers potential for conservation plantings. It grows under low rainfall, can tolerate alkaline and saline conditions, and is palatable and nutritious to most livestock.

**Objective:** The purpose of this study is to evaluate adaptability and produce seed of this species. A South Dakota collection of this species will be evaluated. If the species proves adaptable and useful as a conservation plant, a public release will be the goal.

**Cooperators:** USDA, NRCS Plant Materials Center, Bismarck, North Dakota  
USDA, ARS Northern Great Plains Research Service, Mandan, North Dakota

**Description:** Fourwing saltbush is a long-lived perennial shrub. It has a deep, extensive root system. It is an evergreen gray shrub that grows from 2-6 feet tall. It has many branches. Leaves are alternate, and narrowly oblong. Leaves are scurfy on both sides. Male and female flowers are on separate plants. Flowers are in spikes that form dense panicles. It blooms in late summer. Fruiting bracts have four flat wings from which the plant gets its name. It is palatable to browse and grazing animals. Other common names include fourwing shadscale, white greasewood, salt sage, box brush. Fourwing saltbush differs from Nuttall saltbush. Its most noticeable difference is its four wings on the fruit, as opposed to the warty bracts enclosing the fruit of Nuttall saltbush.

**Distribution:** Fourwing grows on a wide range of soils, from clays to sands, and can tolerate high lime and saline conditions. It is highly drought and heat tolerant. It is native from western North Dakota south to Texas and Mexico, and west to Washington.

### **Methods and Materials**

The study is divided into four parts. These will be listed as:

- 1) Field Trial - PMC
- 2) Source Comparison Trial
- 3) Field Planting - Golden Valley County
- 4) Lincoln-Oakes Nursery Trial

The primary seed source being evaluated is accession 9082680 from South Dakota.

#### **Seed Sources:**

**Accession 9082680** is an *Atriplex canescens*. Seed was collected from several plants at the SDSU Cottonwood Range and Livestock Research Center in Jackson County, South Dakota, by Ron Haigh in 1999. The collection site is in Major Land Resource Area 060A Pierre Shale Plains and Badlands. Its legal description is SE<sup>1</sup>/<sub>4</sub>SW<sup>1</sup>/<sub>4</sub> Sec.16-T1S-R19E. Its latitude is 43°56'57" N and the longitude is 101°51'30" W. The seed was collected in an enclosure area that excluded cattle and wildlife. No other plants of the species are growing in the nearby vicinity except adjacent to the enclosure. These plants are grazed each year, and appear to have abundant regrowth each spring, according to Ron Haigh. A small envelope of seed was given to the PMC in 2000 by Scot Kronberg, USDA, ARS, Mandan, North Dakota. Seed was propagated in the greenhouse for the Field Trial - PMC and Source Comparison Trial. Seed produced from this accession in the Field Trial - PMC was distributed for Field Planting - Golden Valley County and to Lincoln-Oakes Nursery Trial.

**Accession 9082855 Natrona** is an *Atriplex canescens* selection from Wind River Seed Company, Manderson, WY. Seed was propagated in the greenhouse for a Source Comparison Trial. Seed was distributed for Field Planting - Golden Valley County.

**Accession 346419 Wytana** is an *Atriplex aptera* release from the Bridger, Montana PMC. Seed was propagated in the greenhouse for the Source Comparison Trial.

Propagation in the greenhouse was in cone-tainers™, using a soilless potting mix. Seed germinated with no pretreatment. Seedlings of all accessions were vigorous and growth was abundant. Plants were hardened off in a lath house prior to planting in the field.

See sections below for information related to each type of trial or planting.

## 1. Field Trial - PMC

This is located in Panel D10 inside deer fence. Seedlings (25-27) were planted from east to west in a single row on 5/24/2001. The plants were spaced approximately 2 feet apart. Conditions at the time of planting were dry. An additional 4 rows were planted on June 5, 2003, to the north of the 2001 planting. Spacing between the rows was approximately 7 feet. The field was relatively free of growing weeds at the time of planting.

### **Maintenance:**

Weed Control: Hand weeding was done around plants. Thistles were spot sprayed and borders were sprayed with glyphosate. Spraying and mowing between rows has been used to control weeds since 2004. Primary weeds have been kochia, pigweed, lambsquarters, foxtail and some Canada thistle.

Residue Management: No residue was clipped after harvest in 2001, 2002, 2003, 2005, or 2007. Residue was clipped to a 4-8 inch height in November after harvest in 2004, 2006, 2008, 2009, and 2011. Residue from 2007 was clipped in early spring of 2008. After harvest in 2008, residue for the three north rows was clipped. The residue from 2010 was not clipped, and plants remained standing.

### **Seed Harvest:**

Seed has been hand harvested from 2002-2012. Seed was harvested 10/24/2002 and in mid-October through November for all other years. Seed was harvested from a single 50-foot row in 2002 and 2003 and from all rows in 2004-2012.

### **Seed Cleaning:**

2002: Pan screens, a hammer mill with the largest hole screen and a clipper office sized fanning mill with a blank screen on the bottom, 25/64 to 28/64 size screens on top.

2003: Office-sized debearder equipped with rubber corrugation covering the inside, and pan screens.

2004-2012: Debearder and fanning mill.

### **Evaluation:**

Visual observations have been made on plant growth. Seed production has been recorded each year (Table FW-1) and forage quality was tested in 2002 (Table FW-2).

Forage Quality: Forage samples were collected for analysis on 11/6/2002. The tips of top and side branches were clipped on randomly selected plants. The length of the samples averaged 12-15 inches. The samples were then cut into two sections. The top 6 inches, including stem and leaf, were cut and bulked as a sample named TIPS6. Leaves were stripped from the lower remaining 6-9 inches of the original sample and named LF12. Samples were analyzed for ADF, NDF, and Crude Protein by Oscar E. Olson Biochemistry Laboratories at South Dakota State University.

## 2. Source Comparison Trial

A small trial to compare performance of different sources of fourwing saltbush was planted 6/12/2003. Five plants each of three accessions were planted on the north end of panel A in the previous IEP area. Seedlings were grown in the greenhouse and planted to the field on 6/12/2003. Row spacing was 6-7 feet apart. Spacing between plants in the row was approximately 4 feet. Accessions compared were 9082680 (South Dakota), Natrona (Wyoming) and Wytana (Montana). The southernmost row is the Wyoming source, the center row is the South Dakota source, and the northernmost row is Wytana. Size data was collected on growth of each of the sources on 9/24/2003 and on 9/8/2004 (Table FW-3). The trial was removed in 2009.

**3. Field Planting NDPMS-F-0808-RA - Golden Valley County; Cooperator: Scot Steele**

Seed of 9082680 harvested from the Field Trial - PMC and Natrona, purchased from Wind River Seed, were distributed to the Beach, North Dakota, NRCS Field Office for a field planting trial. The Field Planting Number is NDPMS-F-0808-RA. It was seeded with a drill on 5/13/2008 as 20 percent of a range seeding mix in Golden Valley County. Each accession was seeded on 4-5 acres of the total seeding area. Data collection began in the fall of 2008 and will continue for 3-5 years.

**4. Lincoln – Oakes Nursery Trial**

Approximately 1.8 PLS pounds (3 bulk pounds) of 9082680 produced from the Field Trial - PMC was distributed to Lincoln-Oakes Nursery for production of seedlings. Seed was planted in late fall of 2008 in a field bed. The seeding failed to produce a stand.

**Results and Discussion**

**1. Field Trial – PMC (Deer fence)**

Plants in the field were vigorous and were 2-3 feet tall on 9/30/2001. Conditions were dry during the growing season of 2001. No seed was produced the first year of growth. Plants were vigorous in 2002. Height on 8/13/2002 averaged 40 inches for the leafy plants which are males. The females which make up about 1/3 of the plants were extremely heavy with seed pods and reached a height of 30 inches. The seed covering had a green tint at harvest, which was after a hard frost. Conditions in 2003 were very dry, but plants were again quite vigorous. Seedlings planted to extend the field in 2003 were not harvested in 2003. Seed production in 2005 was very poor. Plant residue had been clipped in 2004. The plants were large and woody at the time. It appears that the older the plant when residue is removed, the slower the regrowth. Seed production in 2006 was good and poor in 2007. Plants thought to be females in 2006 were flagged. Some of the flagged plants did not produce seed in 2007. It is not known if they produced pollen as a male plant instead, or if seed set was just poor. Seed production was good in 2008. Plants that did not have the 2007 residue removed produced seed, but were difficult to harvest. Seed production in 2009 was very good and plants were vigorous. Harvests in 2011, 2012, and 2013 were fair. Fewer plants remain in the trial. Gophers and herbicide may have contributed to plants dying. Clipping residue every year or every other year produced the greatest seed harvests. Plants were less woody with only one year of growth. Table FW-1 lists amount of seed harvested each year. Currently, no mechanical harvest method has been found. This is the greatest challenge in seed production.

**2. Source Comparison Trial**

Data collected on 9/24/2003 indicated differences in growth form among the three accessions (see Table FW-3). Overall, plants of Wyoming origin (9082855) were more upright and had less lateral spread and branching than the South Dakota source (9082680). Wytana was not vigorous and showed little growth in 2003. Plants continued to display these growth habits from 2004-2008. The South Dakota source remained slightly larger. Seed production on plants in this trial was sporadic, as it had been in the Field Trial - PMC. Seed was produced on all accessions in 2005 and 2006. Only a few plants within each accession appear to be female and produce seed. Drought in 2006 did not appear to affect plant size. Seed production in 2007 was poor. Size difference between the three accessions was less noticeable in 2007 and 2008. Lack of clipping may have affected growth. The source originating from South Dakota (9086280) continued to be more vigorous in 2008.

**3. Field Planting NDPMS-F-0808-RA - Golden Valley County; Cooperator: Scot Steele**

The accessions 9082680 and Natrona showed little difference in stand establishment. The estimated stand was less than 1 plant per square foot in each planting on 9/19/2008. Records indicating the specific accession planted in a plot are questionable. The Beach Field Office recorded plants as more robust, more branched, and taller in the plot they thought was planted with 9086280. The accessions performed very similar to each other in 2009-2012. Plant vigor was rated good. There was little or no seed production. Evaluations taken by the Beach Field Office in 2010-2012 showed a vigor rating of 1. Moisture conditions this spring and summer were favorable for good growth.

Plans are to remove the PMC field trial planting (deer fence) in 2014. Seed previously harvested will be placed in cold storage.

**Table FW-1. Seed Production – fourwing saltbush *Atriplex canescens*.**

<b>Year</b>	<b>Amount Harvested(clean bulk lbs)</b>
2002	5.5
2003	3.5
2004	6.0
2005	0.5
2006	20.0
2007	5.0
2008	20.0
2009	32.0
2010	7.0
2011	16.0
2012	9.0
2013	21.0

**Table FW-2. Forage analysis data-2002 - fourwing saltbush *Atriplex***

<b>Sample</b>	<b>%Total Moisture</b>	<b>%Crude Protein</b>	<b>%Acid Detergent Fiber</b>	<b>%Neutral Detergent Fiber</b>
LF2	0	22.3	15.2	27.0
LF2	16.5	18.6	12.7	22.5
TIP6	0	18.1	26.3	39.7
TIP6	24.1	13.7	20.0	30.1

**Table FW-3. Evaluation data, 2003-2004 - fourwing saltbush *Atriplex***

<b>Accession</b>	<b>Date</b>	<b>Plant No.</b>	<b>Height</b>	<b>Spread</b>	<b>Fruit 2004</b>
9082855	09/24/03	1	7	31	
9082855	09/08/04	1	33	62	
9082855	09/24/03	2	4	11	
9082855	09/08/04	2	19	30	
9082855	09/24/03	3	16	22	
9082855	09/08/04	3	31	50	
9082855	09/24/03	4	12	16	
9082855	09/08/04	4	26	47	
9082855	09/24/03	5	13	18	
9082855	09/08/04	5	18	50	yes
9082680	09/24/03	1	12	27	
9082680	09/08/04	1	38	49	
9082680	09/24/03	2	3	29	
9082680	09/08/04	2	31	43	yes
9082680	09/24/03	3	5	26	
9082680	09/08/04	3	28	51	
9082680	09/24/03	4	6	42	
9082680	09/08/04	4	36	50	
9082680	09/24/03	5	15	18	
9082680	09/08/04	5	36	48	yes
Wytana	09/24/03	1	3	20	
Wytana	09/08/04	1	23	46	yes
Wytana	09/24/03	2	3	6	
Wytana	09/08/04	2	dead	x	
Wytana	09/24/03	3	2	4	
Wytana	09/08/04	3	11	14	
Wytana	09/24/03	4	2	5	
Wytana	09/08/04	4	5	23	
Wytana	09/24/03	5	7	3	
Wytana	09/08/04	5	13	23	yes

**ACTIVE STUDIES: TECHNICAL REPORT 2013**

<b>Study Number</b>	<b>NDPMC-P-0801-RA</b>
<b>Title</b>	<b>Virginia Wildrye</b> <i>Elymus virginicus</i>
<b>Objective</b>	Develop a broad genetic based northern origin release of Virginia wildrye for use in the Northern Great Plains. Conservation uses could include pasture and hayland planting, wildlife habitat, range seeding, riparian planting and conservation cover
<b>Duration</b>	2008-2016
<b>Cooperators</b>	USDA, NRCS Bismarck Plant Materials Center, Bismarck, North Dakota
<b>Location</b>	Bismarck, ND Plant Materials Center
<b>-----Soils</b>	Mandan Silt Loam
<b>-----MLRA</b>	<b>53B</b>
<b>-----Precip.</b>	<b>2010: 23.18, 2011: 23.22 , 2012:14.9, 2013: 26.75 inches</b>

**Background information:** Virginia wildrye is a native, cool-season, perennial bunchgrass with a height of 2-3 feet. It prefers moist soils. Prime habitat includes bottomlands, low prairies, streambanks, and edges or under trees. It will tolerate both sun and shade. Its heavy horseshoe shaped glumes distinguish it from Canada wildrye. It is a mostly self-pollinating species. It is native throughout most of the United States and Canada.

**Methods and Materials:** Seed was collected from various locations in SD, ND, and MN in 2008 and 2009. Plants were propagated in the greenhouse and planted to an evaluation block. Data collected and visual observations were used to select plants for breeder population. Plants NOT selected were removed from plot. Seed has been harvested from evaluation block and is considered the breeder seed. A foundation seed field has been planted from breeder seed.

**Initial Assembly and Breeder Population**

<b>Seed Source</b>	See <b>Table VW-1</b> for collection dates, collector, and location.
<b>Collections</b>	Years: 2008 and 2009. Collections were from a wide array of sites in SD, ND, MN.
<b>Propagation</b>	Greenhouse to field
<b>-----Greenhouse</b>	Seed planted February 2010 into soilless potting mix in cone-tainers™ (yellow) (1-2 seeds each)
<b>-----Field Evaluation Plot</b>	Seedlings grown in greenhouse were planted on 5/20/2010 to field plot.
<b>-----Location</b>	Panel A
<b>-----Design</b>	Each accession was planted in 3-plant plots and in 3 replications. See <b>Figure VW-1</b> for map.
<b>Data Collection</b>	2010-2012
<b>-----Parameters</b>	Plants were evaluated based on growth habit and size. See <b>Table VW-2</b> .
<b>-----Data</b>	<b>2010:</b> Superior looking plants were rated for their potential use as a forage plant or as a landscape plant. Fifteen heads were collected from each preselected plant so seed would be available quicker if chosen as part of a release. <b>2011:</b> Plants were reselected for the breeder population. Plant material collected in 2010 was discarded. Plants were visually compared when vegetative and again just prior to flowering. Plants of small stature, extremely early or late flowering, diseased, poor vigor, and poor overall plant size were dug and removed from the assembly. Plants from all but three accessions were included in the remaining population which is considered the breeder population. See <b>Table VW-3</b> for a list of accessions included in the breeder population.
<b>Field Maintenance</b>	<b>2010:</b> Shallow tilling between rows and hand weeding. Residue removed by mowing the plants in the fall. <b>2011-2013:</b> Weeds controlled by mowing between rows and hand weeding. Seed that dropped before harvest in 2010 formed a dense mat for mowing. No chemical has been applied to plot.
<b>Seed Harvest</b>	Breeder seed from Panel A has been harvested from 2011-2013 using a combine. <b>2011:</b> 78 bulk pounds (66.5 PLS) <b>2012:</b> 55 bulk pounds <b>2013:</b> 11 bulk pounds
<b>Seed Cleaning</b>	Fanning Mill, no debearding is required.
<b>Foundation Field</b>	A foundation field was seeded in 2013 at the PMC in 42-inch spaced rows.

## **Results and Discussion**

Virginia wildrye grows in diverse conditions and locations. As the species is mostly self-pollinated, parent plants from a variety of locations would provide a diverse population. Though many of the collections were from shady sites, the plants appeared to thrive in direct sun at the PMC. The plants were very vigorous and many produced seed in 2010, the year of transplanting. Seed production was good in 2011 and 2012, but poor in 2013. Drought in 2012 may have caused stress in the plants in 2013. The species also is known to be fairly short lived.

The foundation field planted in the spring of 2013 was vigorous and stand was good by the end of the growing season.

Plans for 2014 include “on farm” field plantings and special plantings for evaluating the species for planting between tree rows.

**Table VW-1. Collections – Virginia wildrye *Elymus virginicus***

Accession	State	County	Collector	Coll. Date	Other
9092245	ND	Richland	Tober	08/08/08	Sheyenne National Grasslands
9092246	ND	Cass	Tober	08/08/08	Conservancy Park on S. Univ. St., Fargo
9092247	MN	Clay	Tober	08/08/08	Regional Science Center 10 mi E of Fargo
9092248	ND	Ransom	Tober	08/08/08	Little Yellowstone Park - east end
9092249	ND	Morton	Jensen	08/11/08	Fort Lincoln State Park, walking trail
9092250	MN	Aitkin	Kopp	08/18/08	8-9 mi E of Hill City on Hwy 200
9092251	MN	Mille Lacs	Tober, Kopp	08/18/08	city park in NW Milaca along Rum River
9092252	ND	Walsh	Tober	08/18/08	Tom Silewski EWP, Exit 172 off I-29
9092253	MN	Aitkin	Tober, Kopp	08/18/08	Hwy 200 E of Hill City, boat ramp
9092254	MN	Sherburne	Tober	08/20/08	Hwy 24 S of Clearwater, Miss. River access
9092255	MN	Sherburne	Kopp	08/20/08	Hwy 24 public access, Miss. River
9092256	MN	Aitkin	Tober, Kopp	08/18/08	Big Sandy Lake Rec Area, Hwy 200 N entrance
9092257	SD	Beadle	Brannan, Yapp	08/20/08	James River Access boat ramp parking lot
9092258	ND	Oliver	Soil Con Training	08/28/08	Smith Grove, along trail to Big Trees
9092259	ND	Emmons	Jensen, Bergsagel	09/13/08	Seeman Park, E of Linton, Hwy 13
9092260	ND	Logan	Bergsagel, Jensen	09/13/08	Beaver Lake State Park, near obelisk
9094261	MN	Rice	Coffman	09/08/08	Jct Co 29 & MN 3, SW side of MN 3
9094262	ND	Morton	Duckwitz	09/06/08	NE1/4 sec 31-T81-R140 below dam
9094263	SD	Clay	Jensen	09/10/08	sec8-T93N-R52W log cabin on bluff road
9094264	SD	Clay	Jensen	09/10/08	Clay Co. Park sec 20-T92N-R52W
9094265	SD	Yankton	Jensen	09/10/08	Clay Creek, S of Volin, sec26-T94N-R54W
9094266	SD	Union	Jensen	09/10/08	Union Grove State Park ,sec32-T94N-R50W
9094267	ND	Oliver	Jensen, Bergsagel	09/13/08	Arroda Lakes - west entrance
9094268	ND	Mercer	Bergsagel, Jensen	09/16/08	Stanton City Park along Knife River
9094269	ND	Mercer	Jensen, Bergsagel	09/13/08	Sakakawea Estates; S of Lake Sakakawea
9094270	ND	Dunn	Bergsagel, Jensen	09/16/08	Killdeer Mt WMA drainage area, NW parking lot
9094271	ND	Stark	Jensen, Bergsagel	09/16/08	Schnell Ranch -Woodland Trail (OWLS)
9094272	ND	Barnes	Jensen	10/02/08	Conservancy Park along Sheyenne River S of Valley City, woods - north end
9094273	SD	Hanson	Adams, Gilb	08/22/08	James River banks 8-T101N-R58W
9094274	SD	Dewey	Richter, Beer, Boltjes	10/02/08	Virgin Creek, 28-T15N-R29E
9094275	ND	Kidder	Jensen, Tober	10/08/08	Lake Isabel, E side, 26-T139N-72W
9094276	ND	Griggs	Tober	10/08/08	Red Willow Lake Resort Rd to Heifer Stadium
9094277	MN	Polk	Jensen	10/08/08	Roger Wagner Nursery, Red Lake River bottoms
9094278	ND	Nelson	Tober, Jensen	10/08/08	Stump Lake Recreation Area

Accession	State	County	Collector	Coll. Date	Other
9094283	MN	Marshall	Gustafson,Rivard,Kaul	09/01/09	sec30-T157N-R50W EWP
9094284	MN	Marshall	Gustafson,Rivard,Kaul	09/01/09	sec27-T157N-R50W EWP
9094285	MN	Red Lake	Shawnn Balstad	08/24/09	Riverside Park, north of watergrazing station
9094286	SD	Corson	Jensen, Bergsagel	09/08/09	South of Little Eagle along SD 63, Sec 29 T20N R27E
9094287	SD	Jackson	Jensen, Bergsagel	09/10/09	Hwy 44 Bear in the Lodge Creek; 12-T41N-R38W, W of Wanblee, SD
9094288	SD	Custer	Jensen, Bergsagel	09/09/09	Beaver Creek in Wind Cave National Park
9094289	SD	Harding	Jensen, Bergsagel	09/08/09	Slim Buttes (Reva campgrounds)
9094290	SD	Shannon	Jensen, Bergsagel	09/10/09	11 mi N Oglala along Hwy 41, White River bridge
9094291	SD	Mellette	Jensen, Bergsagel	09/10/09	Off Hwy 44, 5 1/2 E of SD Hwy 63, woody draws
9094292	SD	Perkins	Jensen, Bergsagel	09/08/09	Humphrey Draw, Grand River National Grasslands
9094293	SD	Fall River	Jensen, Bergsagel	09/10/09	Brookside Park in city of Hot Springs
9094294	SD	Stanley	Jensen, Bergsagel	09/11/09	Off Hwy 1806 near Oahe Dam, mile mark 191
9094295	SD	Butte	Jensen, Bergsagel	09/09/09	T8N-R2E City of Belle Fourche walking trail
9094296	SD	Lawrence	Jensen, Bergsagel	09/09/09	Rough Lock Falls Trail Head, campground
9094297	SD	Roberts	Tober	09/17/09	Siche Hollow, scattered locations along trail
9094298	SD	Roberts	Tober	09/17/09	Browns Valley, MN COE Rec area north of Lake Traverse(city)
9094299	SD	Big Stone	Tober	09/17/09	Graceville, MN - west end of Toqua Park
9094300	MN	Douglas	Tober	09/16/09	Spruce Hill Park N of Alexandria 20 mi., drainage from picnic shelters, footbridge
9094301	MN	Wadena	Tober	09/16/09	Old Wadena along Crow Wing River by canoe landing and picnic area
9094302	MN	Beltrami	Tober	09/14/09	6 mi S of Blackduck on Hwy 39; Gilstad Lake boat ramp area in trees
9094303	MN	Norman	Tober	09/14/09	Bosworth Park along Marsh River at Ada, MN
9094304	SD	Hutchinson	Jensen	09/21/09	Walz GMA; 7 mi N of Menno, SD along 431st Av - woody draws
9094305	SD	Hand	Jensen	09/17/09	St. Lawrence Nature Park east side of town by old pavilion
9094307	MN	Carlton	Jensen, M. Oja	09/30/09	Cloquet Forest, cut forest area by global warming trial
9094308	SD	Grant	Jensen, Bergsagel	10/07/09	S of Twin Brooks, from Hwy 20, 1 mi N to 156st, E 1 mi, then S on 473 Av 1/10 mi
9094309	ND	McHenry	Jensen, Bergsagel	10/08/09	Velva City Park, along Mouse River riparian area near horseshoe pit
9094310	ND	McLean	Jensen, Bergsagel	10/08/09	Ft Mandan, in trees N of Seeman sculpture
9094311	MN	Yellow Medicine	Jensen, Bergsagel	10/07/09	N of Canby at Yellow Medicine/Lac Qui Parle Co line; 280 Av 1/2 mi E of Hwy 75
9094312	MN	Lac Qui Parle	Jensen, Bergsagel	10/07/09	S of Madison, MN, on 211 Ave near bridge #37513
9094313	MN	Sherburne	Tober	09/28/09	Princeton, MN Riverside Park (Hwy 95) along Rum River
9094314	SD	Brookings	Jensen, Bergsagel	10/07/09	S of Brookings, off of Co. Rd 77, at Conservation Park along Big Sioux River
9094315	SD	Minnehaha	Jensen, Bergsagel	10/06/09	Dell Rapids City Park by old Bath House along Big Sioux River
9094316	MN	Pipestone	Jensen, Bergsagel	10/06/09	Pipestone National Monument trail near headquarters
9094317	MN	Murray	Jensen, Bergsagel	10/06/09	Lime Lake Park (Murray Co. Park) W of Avoca, MN; along dam face
9094318	MN	Cottonwood	Jensen, Bergsagel	10/06/09	High Water Creek along Hwy 10, just E of Co. Rd 5, baseball area at bridge

Accession	State	County	Collector	Coll. Date	Other
9094319	MN	Redwood	Jensen, Bergsagel	10/06/09	Plum Creek Co. Park 2 mi S of Walnut Grove, near foot bridge
9094320	MN	Lyon	Jensen, Bergsagel	10/06/09	Garvin Park N of Hwy 14; 280th Av & Co. Rd 69, picnic area along creek
9094321	MN	Lincoln	Jensen, Bergsagel	10/06/09	Lake Benton; Hole in Mountain Co. Park, outer edge of hills and draws
9094322	SD	Marshall	Jensen, Bergsagel	10/05/09	GF&P walk in area, 2 mi W of Veblen, SD( Hwy 25) along creek in draw
9094323	ND	McKenzie	Bergsagel	10/04/09	Bennie Peer Rd, 3.3 mi W of Hwy 16; E of Tim Dwyer place (Little Mo. Grasslands)
9094324	ND	Golden Valley	Bergsagel	10/04/09	Buffalo Gap Campground, along I-94, sites 20, 22 in center of Hidatsa Loop
9094325	ND	Burleigh	Jensen, Bergsagel	09/02/09	Sibley Park south of Bismarck, east end of park, west of boat ramp, woods
9094326	MN	Lac Qui Parle	L. Kvidera	10/13/09	Sec 21-T117N-R44W, N side of Lac Qui Parle River, Co. Rd. #37
9094327	ND	Renville	Jensen, Bergsagel	10/19/09	Upper Souris National Wildlife Refuge, N of Mouse River Co Prk, W of Mohall
9094328	ND	Bottineau	Jensen, Bergsagel	10/19/09	Lake Metigoshe State Park - Day Use and Tent Loop
9094329	ND	Mountrail	Jensen, Bergsagel	10/19/09	1.7 mi S of Hwy 2, W of White Earth Rest Area
9094330	ND	Ward	Jensen, Bergsagel	10/19/09	Oak Park in Minot, at Camp Owetti along trail along Mouse River (Souris)

Figure VW-1. Plot Layout – Virginia wildrye *Elymus virginicus* (page 1 of 3)

Location: Panel A

Planting Date: 5/20/2010

row 1	row 2	row 3	row 4	row 5	row 6	row 7	row 8	row 9	row 10
9092245	9092254	9094263	9094272	9094285	9094294	9094303	9094313	9094322	Cuivre
9092245	9092254	9094263	9094272	9094285	9094294	9094303	9094313	9094322	Cuivre
9092245	9092254	9094263	9094272	9094285	9094294	9094303	9094313	9094322	Cuivre
9092246	9092255	9094264	9094273	9094286	9094295	9094304	9094314	9094323	EWP
9092246	9092255	9094264	9094273	9094286	9094295	9094304	9094314	9094323	EWP
9092246	9092255	9094264	9094273	9094286	9094295	9094304	9094314	9094323	EWP
9092247	9092256	9094265	9094274	9094287	9094296	9094305	9094315	9094324	9094276
9092247	9092256	9094265	9094274	9094287	9094296	9094305	9094315	9094324	9094276
9092247	9092256	9094265	9094274	9094287	9094296	9094305	9094315	9094324	9094276
9092248	9092257	9094266	9094275	9094288	9094297	9094307	9094316	9094325	9094317
9092248	9092257	9094266	9094275	9094288	9094297	9094307	9094316	9094325	9094317
9092248	9092257	9094266	9094275	9094288	9094297	9094307	9094316	9094325	9094317
9092249	9092258	9094267	9094276	9094289	9094298	9094308	9094317	9094326	9094288
9092249	9092258	9094267	9094276	9094289	9094298	9094308	9094317	9094326	9094288
9092249	9092258	9094267	9094276	9094289	9094298	9094308	9094317	9094326	9094288
9092250	9092259	9094268	9094277	9094290	9094299	9094309	9094318	9094327	9092256
9092250	9092259	9094268	9094277	9094290	9094299	9094309	9094318	9094327	9092256
9092250	9092259	9094268	9094277	9094290	9094299	9094309	9094318	9094327	9092256
9092251	9092260	9094269	9094278	9094291	9094300	9094310	9094319	9094328	9094267
9092251	9092260	9094269	9094278	9094291	9094300	9094310	9094319	9094328	9094267
9092251	9092260	9094269	9094278	9094291	9094300	9094310	9094319	9094328	9094267
9092252	9094261	9094270	9094283	9094292	9094301	9094311	9094320	9094329	9094290
9092252	9094261	9094270	9094283	9094292	9094301	9094311	9094320	9094329	9094290
9092252	9094261	9094270	9094283	9094292	9094301	9094311	9094320	9094329	9094290
9092253	9094262	9094271	9094284	9094293	9094302	9094312	9094321	9094330	9094285
9092253	9094262	9094271	9094284	9094293	9094302	9094312	9094321	9094330	9094285
9092253	9094262	9094271	9094284	9094293	9094302	9094312	9094321	9094330	9094285

Figure VW-1. Plot Layout – Virginia wildrye *Elymus virginicus* (continued - page 2 of 3)

Location: Panel A  
 Planting Date: 5/20/2010

row 11	row 12	row 13	row 14	row 15	row 16	row 17	row 18	row 19	row 20
9094329	9094283	9094299	9094278	9094289	9094326	9094325	9092250	9094268	9094271
9094329	9094283	9094299	9094278	9094289	9094326	9094325	9092250	9094268	9094271
9094329	9094283	9094299	9094278	9094289	9094326	9094325	9092250	9094268	9094271
9094293	9094295	9092252	9094312	9094321	9094323	9092254	9092258	9094308	9094287
9094293	9094295	9092252	9094312	9094321	9094323	9092254	9092258	9094308	9094287
9094293	9094295	9092252	9094312	9094321	9094323	9092254	9092258	9094308	9094287
9092249	9092247	9094277	9094330	9094305	9094316	9094315	9092245	9094307	9092258
9092249	9092247	9094277	9094330	9094305	9094316	9094315	9092245	9094307	9092258
9092249	9092247	9094277	9094330	9094305	9094316	9094315	9092245	9094307	9092258
9094266	Cuivre	9092260	9094298	9094265	9094324	9094273	9094294	9094309	9092259
9094266	Cuivre	9092260	9094298	9094265	9094324	9094273	9094294	9094309	9092259
9094266	Cuivre	9092260	9094298	9094265	9094324	9094273	9094294	9094309	9092259
9094275	9094284	9094272	9094297	9094264	9094263	9094269	9092257	9094317	9094325
9094275	9094284	9094272	9094297	9094264	9094263	9094269	9092257	9094317	9094325
9094275	9094284	9094272	9094297	9094264	9094263	9094269	9092257	9094317	9094325
9094318	9094302	EWP	9094303	9094292	9094270	9094261	9094287	9094283	9094310
9094318	9094302	EWP	9094303	9094292	9094270	9094261	9094287	9094283	9094310
9094318	9094302	EWP	9094303	9094292	9094270	9094261	9094287	9094283	9094310
9094313	9092248	9094300	9094319	9094322	9094314	9094327	9094328	9094316	9094300
9094313	9092248	9094300	9094319	9094322	9094314	9094327	9094328	9094316	9094300
9094313	9092248	9094300	9094319	9094322	9094314	9094327	9094328	9094316	9094300
9094296	9094291	9094274	9094304	9094286	9092255	9092253	9094262	9092257	9094321
9094296	9094291	9094274	9094304	9094286	9092255	9092253	9094262	9092257	9094321
9094296	9094291	9094274	9094304	9094286	9092255	9092253	9094262	9092257	9094321
9092246	9094301	9092251	9094310	9094271	9092259	9094320	9094311	9094292	9094266
9092246	9094301	9092251	9094310	9094271	9092259	9094320	9094311	9094292	9094266
9092246	9094301	9092251	9094310	9094271	9092259	9094320	9094311	9094292	9094266

Figure VW-1. Plot Layout – Virginia wildrye *Elymus virginicus* (continued - page 3 of 3)

Location: Panel A  
 Planting Date: 5/20/2010

row 21	row 22	row 23	row 24	row 25	row 26	row 27	row 28
9094276	9094275	9094261	9092248	9094323	9094318	9092254	9094270
9094276	9094275	9094261	9092248	9094323	9094318	9092254	9094270
9094276	9094275	9094261	9092248	9094323	9094318	9092254	9094270
9094312	9092245	9094326	9094298	9094328	9094305	9094300	9092252
9094312	9092245	9094326	9094298	9094328	9094305	9094300	9092252
9094312	9092245	9094326	9094298	9094328	9094305	9094300	9092252
9092255	9094327	9094267	9094286	9094262	9094295	Cuivre	9094301
9092255	9094327	9094267	9094286	9094262	9094295	Cuivre	9094301
9092255	9094327	9094267	9094286	9094262	9094295	Cuivre	9094301
9094308	9094288	9094294	9094320	9094303	9094274	9094265	9094296
9094308	9094288	9094294	9094320	9094303	9094274	9094265	9094296
9094308	9094288	9094294	9094320	9094303	9094274	9094265	9094296
9094329	9094273	9094324	9094313	9092260	9094297	9094264	9094269
9094329	9094273	9094324	9094313	9092260	9094297	9094264	9094269
9094329	9094273	9094324	9094313	9092260	9094297	9094264	9094269
9094289	9094263	9094304	9094322	9092251	9094268	EWP	9094290
9094289	9094263	9094304	9094322	9092251	9094298	EWP	9094290
9094289	9094263	9094304	9094322	9092251	9094268	EWP	9094290
9094314	9092253	9094302	9092250	9094278	9094319	9094272	
9094314	9092253	9094302	9092250	9094278	9094319	9094272	
9094314	9092253	9094302	9092250	9094278	9094319	9094272	
9092247	9094309	9094284	9092256	9094277	9094299	9092249	
9092247	9094309	9094284	9092256	9094277	9094299	9092249	
9092247	9094309	9094284	9092256	9094277	9094299	9092249	
9094315	9094293	9094285	9094291	9092246	9094307	9094311	
9094315	9094293	9094285	9094291	9092246	9094307	9094311	
9094315	9094293	9094285	9094291	9092246	9094307	9094311	

**Table VW-2. 2010 Evaluation data – Virginia wildrye *Elymus virginicus***

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Height rating 1=tall 3=short	2010 HV turf/short preselect
1	1	9092245		2	
1	2	9092245		2	
1	3	9092245		2	
1	1	9092246		2	
1	2	9092246		2	
1	3	9092246		2	
1	1	9092247	x	1	
1	2	9092247		1	
1	3	9092247		1	
1	1	9092248		3	x
1	2	9092248		3	x
1	3	9092248		3	x
1	1	9092249		2	
1	2	9092249		2	
1	3	9092249		2	
1	1	9092250	x	1	
1	2	9092250	x	1	
1	3	9092250		1	
1	1	9092251		1	
1	2	9092251		1	
1	3	9092251	x	1	
1	1	9092252		1	
1	2	9092252		1	
1	3	9092252	x	1	
1	1	9092253		1	
1	2	9092253		1	
1	3	9092253		1	
		<b>ROW 2</b>			
2	1	9092254		1	
2	2	9092254		1	
2	3	9092254	x	1	
2	1	9092255	x	1	
2	2	9092255	x	1	
2	3	9092255	x	1	
2	1	9092256		2	
2	2	9092256		2	
2	3	9092256		1	
2	1	9092257		1	
2	2	9092257		1	
2	3	9092257		1	
2	1	9092258		3	
2	2	9092258		3	x
2	3	9092258		3	x
2	1	9092259		2	
2	2	9092259		2	
2	3	9092259		2	
2	1	9092260		2	
2	2	9092260		2	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Height rating 1=tall 3=short	2010 HV turf/short preselect
2	3	9092260		2	
2	1	9094261		1	
2	2	9094261		2	
2	3	9094261	x	1	
2	1	9094262		2	
2	2	9094262		2	
2	3	9094262		2	
		<b>ROW 3</b>			
3	1	9094263		2	
3	2	9094263		2	
3	3	9094263		2	
3	1	9094264		3	
3	2	9094264		3	
3	3	9094264		3	
3	1	9094265		1	
3	2	9094265	x	1	
3	3	9094265		1	
3	1	9094266		3	x
3	2	9094266		1	
3	3	9094266		2	
3	1	9094267		2	
3	2	9094267		2	
3	3	9094267		2	
3	1	9094268		1	
3	2	9094268		1	
3	3	9094268		2	
3	1	9094269		2	
3	2	9094269		2	
3	3	9094269		2	
3	1	9094270		2	
3	2	9094270		2	
3	3	9094270		2	
3	1	9094271		3	
3	2	9094271		3	
3	3	9094271		2	
		<b>ROW 4</b>			
4	1	9094272		2	
4	2	9094272		3	
4	3	9094272	x	2	
4	1	9094273		3	
4	2	9094273		3	
4	3	9094273		2	
4	1	9094274		2	
4	2	9094274		2	
4	3	9094274		2	
4	1	9094275		2	
4	2	9094275		2	
4	3	9094275		2	
4	1	9094276		3	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Height rating 1=tall 3=short	2010 HV turf/short preselect
4	2	9094276		3	
4	3	9094276		3	
4	1	9094277		1	
4	2	9094277	x	1	
4	3	9094277		2	
4	1	9094278		2	
4	2	9094278		2	
4	3	9094278		1	
4	1	9094283	x	1	
4	2	9094283		1	
4	3	9094283	x	1	
4	1	9094284		1	
4	2	9094284	x	1	
4	3	9094284		2	
		<b>ROW 5</b>			
5	1	9094285		2	
5	2	9094285		2	
5	3	9094285	x	1	
5	1	9094286		1	
5	2	9094286		1	
5	3	9094286		2	
5	1	9094287		3	x
5	2	9094287		3	x
5	3	9094287		3	x
5	1	9094288		2	
5	2	9094288		2	
5	3	9094288		2	
5	1	9094289		3	
5	2	9094289		2	
5	3	9094289		2	
5	1	9094290		1	
5	2	9094290		2	
5	3	9094290		2	
5	1	9094291		1	
5	2	9094291		2	
5	3	9094291		2	
5	1	9094292		2	
5	2	9094292		2	
5	3	9094292		2	
5	1	9094293		1	
5	2	9094293		1	
5	3	9094293		1	
		<b>ROW 6</b>			
6	1	9094294		2	
6	2	9094294		1	
6	3	9094294		1	
6	1	9094295		1	
6	2	9094295		2	
6	3	9094295		2	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Height rating 1=tall 3=short	2010 HV turf/short preselect
6	1	9094296		2	
6	2	9094296		2	
6	3	9094296		2	
6	1	9094297		2	
6	2	9094297		1	
6	3	9094297		2	
6	1	9094298	x	1	
6	2	9094298	x	1	
6	3	9094298	x	1	
6	1	9094299		2	
6	2	9094299		2	
6	3	9094299		2	
6	1	9094300	x	1	
6	2	9094300		1	
6	3	9094300		2	
6	1	9094301	x	1	
6	2	9094301		1	
6	3	9094301		2	
6	1	9094302		1	
6	2	9094302		1	
6	3	9094302		1	
		<b>ROW 7</b>			
7	1	9094303		2	
7	2	9094303		2	
7	3	9094303		2	
7	1	9094304		2	
7	2	9094304		2	
7	3	9094304		2	
7	1	9094305		2	x
7	2	9094305		3	x
7	3	9094305		2	x
7	1	9094307		2	
7	2	9094307		2	
7	3	9094307		1	
7	1	9094308		2	
7	2	9094308		2	
7	3	9094308		2	
7	1	9094309		2	
7	2	9094309		1	
7	3	9094309		2	
7	1	9094310		1	
7	2	9094310	x	1	
7	3	9094310		1	
7	1	9094311	x	1	
7	2	9094311		1	
7	3	9094311		1	
7	1	9094312	x	1	
7	2	9094312	x	2	
7	3	9094312	x	1	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Height rating 1=tall 3=short	2010 HV turf/short preselect
<b>ROW 8</b>					
8	1	9094313		2	
8	2	9094313	x	1	
8	3	9094313	x	1	
8	1	9094314	x	1	
8	2	9094314		2	
8	3	9094314	x	1	
8	1	9094315		2	
8	2	9094315		2	
8	3	9094315		2	x
8	1	9094316		2	
8	2	9094316		1	
8	3	9094316		1	
8	1	9094317		2	
8	2	9094317		2	
8	3	9094317		2	
8	1	9094318	x	1	
8	2	9094318	x	1	
8	3	9094318	x	1	
8	1	9094319		1	
8	2	9094319		1	
8	3	9094319		1	
8	1	9094320		2	
8	2	9094320		1	
8	3	9094320		3	
8	1	9094321		2	x
8	2	9094321		2	x
8	3	9094321		2	x
<b>ROW 9</b>					
9	1	9094322		3	
9	2	9094322		2	
9	3	9094322		2	
9	1	9094323		2	
9	2	9094323		2	
9	3	9094323		3	
9	1	9094324		3	
9	2	9094324		2	
9	3	9094324		2	
9	1	9094325		1	
9	2	9094325		1	
9	3	9094325		1	
9	1	9094326		1	
9	2	9094326	x	1	
9	3	9094326	x	1	
9	1	9094327		1	
9	2	9094327		2	
9	3	9094327		2	
9	1	9094328		3	
9	2	9094328		3	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Height rating 1=tall 3=short	2010 HV turf/short preselect
9	3	9094328		3	
9	1	9094329		1	
9	2	9094329		1	
9	3	9094329		3	
9	1	9094330		2	
9	2	9094330		3	
9	3	9094330		2	
		<b>ROW 10</b>			
10	1	Cuivre		2	
10	2	Cuivre		1	
10	3	Cuivre		1	
10	1	EWP		1	
10	2	EWP		1	
10	3	EWP	x	1	
10	1	9094276		3	
10	2	9094276		3	
10	3	9094276		3	
10	1	9094317		2	
10	2	9094317		3	
10	3	9094317		3	
10	1	9094288		3	
10	2	9094288		2	
10	3	9094288		1	
10	1	9092256		1	
10	2	9092256		1	
10	3	9092256	x	1	
10	1	9094267		2	
10	2	9094267		2	
10	3	9094267		2	
10	1	9094290		2	
10	2	9094290		1	
10	3	9094290		3	
10	1	9094285		3	
10	2	9094285		3	
10	3	9094285		1	
		<b>ROW 11</b>			
11	1	9094329		3	
11	2	9094329		3	
11	3	9094329		2	
11	1	9094293		1	
11	2	9094293		2	
11	3	9094293		2	
11	1	9092249		3	
11	2	9092249		3	
11	3	9092249		3	
11	1	9094266		1	
11	2	9094266		1	
11	3	9094266		3	
11	1	9094275		3	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Height rating 1=tall 3=short	2010 HV turf/short preselect
11	2	9094275		3	
11	3	9094275		2	
11	1	9094318		1	
11	2	9094318		1	
11	3	9094318	x	1	
11	1	9094313		1	
11	2	9094313	x	1	
11	3	9094313		1	
11	1	9094296		2	
11	2	9094296		2	
11	3	9094296		2	
11	1	9092246		1	
11	2	9092246		1	
11	3	9092246		1	
		<b>ROW 12</b>			
12	1	9094283		2	
12	2	9094283		1	
12	3	9094283	x	1	
12	1	9094295		1	
12	2	9094295	x	1	
12	3	9094295		2	
12	1	9092247	x	1	
12	2	9092247		1	
12	3	9092247		1	
12	1	Cuivre		1	
12	2	Cuivre		2	
12	3	Cuivre		2	
12	1	9094284		1	
12	2	9094284	x	1	
12	3	9094284	x	1	
12	1	9094302		1	
12	2	9094302		1	
12	3	9094302	x	1	
12	1	9092248		2	x
12	2	9092248		2	x
12	3	9092248		2	x
12	1	9094291		2	
12	2	9094291		3	
12	3	9094291		2	
12	1	9094301	x	1	
12	2	9094301	x	1	
12	3	9094301		1	
		<b>ROW 13</b>			
13	1	9094299		3	
13	2	9094299		3	x
13	3	9094299		2	
13	1	9092252		1	
13	2	9092252	x	1	
13	3	9092252		1	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Height rating 1=tall 3=short	2010 HV turf/short preselect
13	1	9094277	x	1	
13	2	9094277		1	
13	3	9094277		1	
13	1	9092260		3	
13	2	9092260		3	
13	3	9092260		2	
13	1	9094272	x	1	
13	2	9094272		2	
13	3	9094272		2	
13	1	EWP		1	
13	2	EWP	x	1	
13	3	EWP		1	
13	1	9094300		1	
13	2	9094300		1	
13	3	9094300		1	
13	1	9094274		3	
13	2	9094274		2	x
13	3	9094274		1	
13	1	9092251		1	
13	2	9092251		1	
13	3	9092251		1	
		<b>ROW 14</b>			
14	1	9094278		2	
14	2	9094278		2	
14	3	9094278		2	
14	1	9094312	x	1	
14	2	9094312	x	1	
14	3	9094312		1	
14	1	9094330		2	
14	2	9094330		2	x
14	3	9094330		2	x
14	1	9094298		1	
14	2	9094298	x	1	
14	3	9094298		1	
14	1	9094297		1	
14	2	9094297		1	
14	3	9094297		1	
14	1	9094303		1	
14	2	9094303		1	
14	3	9094303	x	1	
14	1	9094319		1	
14	2	9094319		1	
14	3	9094319		1	
14	1	9094304		2	
14	2	9094304		2	
14	3	9094304		3	
14	1	9094310		1	
14	2	9094310		1	
14	3	9094310		1	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Height rating 1=tall 3=short	2010 HV turf/short preselect
<b>ROW 15</b>					
15	1	9094289		3	
15	2	9094289		3	
15	3	9094289		2	
15	1	9094321		2	
15	2	9094321		2	
15	3	9094321		2	
15	1	9094305		3	x
15	2	9094305		3	x
15	3	9094305		3	x
15	1	9094265		1	
15	2	9094265		1	
15	3	9094265		1	
15	1	9094264		2	
15	2	9094264		2	
15	3	9094264		2	
15	1	9094292		2	
15	2	9094292		2	
15	3	9094292		2	
15	1	9094322		2	
15	2	9094322		2	
15	3	9094322		2	
15	1	9094286		1	
15	2	9094286		1	
15	3	9094286		1	
15	1	9094271		2	
15	2	9094271		2	
15	3	9094271		2	
<b>ROW 16</b>					
16	1	9094326		1	
16	2	9094326		1	
16	3	9094326	x	1	
16	1	9094323		1	
16	2	9094323	x	1	
16	3	9094323		2	
16	1	9094316		2	
16	2	9094316		2	
16	3	9094316		2	
16	1	9094324		2	
16	2	9094324		2	
16	3	9094324		2	
16	1	9094263		1	
16	2	9094263		2	
16	3	9094263		2	
16	1	9094270		2	
16	2	9094270		2	
16	3	9094270		1	
16	1	9094314		1	
16	2	9094314	x	1	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Height rating 1=tall 3=short	2010 HV turf/short preselect
16	3	9094314		2	
16	1	9092255		1	
16	2	9092255	x	1	
16	3	9092255		1	
16	1	9092259		2	
16	2	9092259		1	
16	3	9092259		2	
		<b>ROW 17</b>			
17	1	9094325		2	
17	2	9094325		1	
17	3	9094325		1	
17	1	9092254		1	
17	2	9092254		2	
17	3	9092254	x	1	
17	1	9094315		2	
17	2	9094315		2	x
17	3	9094315		2	x
17	1	9094273		1	
17	2	9094273		1	
17	3	9094273		1	
17	1	9094269		2	
17	2	9094269		1	
17	3	9094269		2	
17	1	9094261		1	
17	2	9094261		1	
17	3	9094261		1	
17	1	9094327		2	
17	2	9094327		2	
17	3	9094327		3	
17	1	9092253		1	
17	2	9092253		1	
17	3	9092253		1	
17	1	9094320		1	
17	2	9094320		1	
17	3	9094320		1	
		<b>ROW 18</b>			
18	1	9092250		2	
18	2	9092250		1	
18	3	9092250		1	
18	1	9092258		2	
18	2	9092258		2	x
18	3	9092258		2	x
18	1	9092245		2	x
18	2	9092245		2	x
18	3	9092245		2	
18	1	9094294		1	
18	2	9094294		2	
18	3	9094294		1	
18	1	9092257	x	2	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Height rating 1=tall 3=short	2010 HV turf/short preselect
18	2	9092257		2	
18	3	9092257		3	
18	1	9094287		3	x
18	2	9094287		3	x
18	3	9094287		3	x
18	1	9094328		3	
18	2	9094328		3	
18	3	9094328		3	
18	1	9094262		2	
18	2	9094262		2	
18	3	9094262		2	
18	1	9094311		1	
18	2	9094311		1	
18	3	9094311	x	1	
		<b>ROW 19</b>			
19	1	9094268		2	
19	2	9094268		1	
19	3	9094268		1	
19	1	9094308		1	
19	2	9094308		2	
19	3	9094308		2	
19	1	9094307		3	x
19	2	9094307		2	
19	3	9094307		2	
19	1	9094309		2	x
19	2	9094309		2	
19	3	9094309		2	
19	1	9094317		2	
19	2	9094317		2	x
19	3	9094317		2	x
19	1	9094283		1	
19	2	9094283	x	1	
19	3	9094283	x	1	
19	1	9094316		1	
19	2	9094316		1	
19	3	9094316		1	
19	1	9092257		1	
19	2	9092257		1	
19	3	9092257		1	
19	1	9094292		2	
19	2	9094292		2	
19	3	9094292		2	
		<b>ROW 20</b>			
20	1	9094271		3	
20	2	9094271		2	
20	3	9094271		2	
20	1	9094287		2	
20	2	9094287		2	
20	3	9094287		2	x

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Height rating 1=tall 3=short	2010 HV turf/short preselect
20	1	9092258		2	
20	2	9092258		2	
20	3	9092258		2	
20	1	9092259		2	
20	2	9092259		2	
20	3	9092259		1	
20	1	9094325		1	
20	2	9094325		1	
20	3	9094325		1	
20	1	9094310		3	
20	2	9094310		2	
20	3	9094310		1	
20	1	9094300	x	2	
20	2	9094300		1	
20	3	9094300		1	
20	1	9094321		2	x
20	2	9094321		2	x
20	3	9094321		2	
20	1	9094266		1	
20	2	9094266		1	
20	3	9094266		2	
		<b>ROW 21</b>			
21	1	9094276		3	
21	2	9094276		3	
21	3	9094276		2	
21	1	9094312	x	1	
21	2	9094312	x	1	
21	3	9094312	x	1	
21	1	9092255		1	
21	2	9092255		1	
21	3	9092255	x	1	
21	1	9094308		2	
21	2	9094308		2	
21	3	9094308		2	
21	1	9094329		2	
21	2	9094329		2	
21	3	9094329		3	
21	1	9094289		2	
21	2	9094289		2	
21	3	9094289		2	
21	1	9094314		1	
21	2	9094314		2	x
21	3	9094314		2	x
21	1	9092247		3	
21	2	9092247		3	
21	3	9092247		2	
21	1	9094315		2	x
21	2	9094315		2	x
21	3	9094315		1	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Height rating 1=tall 3=short	2010 HV turf/short preselect
		<b>ROW 22</b>			
22	1	9094275		2	
22	2	9094275		2	
22	3	9094275		2	
22	1	9092245		2	
22	2	9092245		2	
22	3	9092245		3	
22	1	9094327		2	
22	2	9094327		2	
22	3	9094327		1	
22	1	9094288		2	
22	2	9094288		2	
22	3	9094288		2	
22	1	9094273		2	
22	2	9094273		3	
22	3	9094273		2	
22	1	9094263		2	
22	2	9094263		1	
22	3	9094263		1	
22	1	9092253		1	
22	2	9092253		1	
22	3	9092253		1	
22	1	9094309		2	
22	2	9094309	x	2	
22	3	9094309	x	2	
22	1	9094293		1	
22	2	9094293		1	
22	3	9094293		1	
		<b>ROW 23</b>			
23	1	9094261		3	
23	2	9094261		2	
23	3	9094261	x	1	
23	1	9094326		1	
23	2	9094326		1	
23	3	9094326	x	1	
23	1	9094267		2	
23	2	9094267		2	
23	3	9094267		dead	
23	1	9094294		2	
23	2	9094294		2	
23	3	9094294		3	
23	1	9094324		2	
23	2	9094324		2	
23	3	9094324		2	
23	1	9094304		2	
23	2	9094304		2	
23	3	9094304		2	
23	1	9094302		1	
23	2	9094302	x	1	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Height rating 1=tall 3=short	2010 HV turf/short preselect
23	3	9094302	x	1	
23	1	9094284		1	
23	2	9094284		1	
23	3	9094284	x	1	
23	1	9094285		1	
23	2	9094285		2	
23	3	9094285		1	
		<b>ROW 24</b>			
24	1	9092248		3	
24	2	9092248		2	x
24	3	9092248		2	x
24	1	9094298		1	
24	2	9094298	x	1	
24	3	9094298	x	1	
24	1	9094286		1	
24	2	9094286		1	
24	3	9094286		1	
24	1	9094320		2	
24	2	9094320		2	
24	3	9094320		1	
24	1	9094313		1	
24	2	9094313	x	1	
24	3	9094313		2	
24	1	9094322		2	
24	2	9094322		2	
24	3	9094322		2	
24	1	9092250		2	
24	2	9092250		1	
24	3	9092250	x	1	
24	1	9092256		1	
24	2	9092256		1	
24	3	9092256		2	
24	1	9094291		1	
24	2	9094291		1	
24	3	9094291		1	
		<b>ROW 25</b>			
25	1	9094323		2	
25	2	9094323		2	
25	3	9094323		2	
25	1	9094328		2	
25	2	9094328		2	
25	3	9094328	x	1	
25	1	9094262		2	
25	2	9094262		1	
25	3	9094262		1	
25	1	9094303		1	
25	2	9094303	x	1	
25	3	9094303		2	
25	1	9092260		2	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Height rating 1=tall 3=short	2010 HV turf/short preselect
25	2	9092260		2	
25	3	9092260		2	
25	1	9092251		2	
25	2	9092251		2	
25	3	9092251		2	
25	1	9094278		1	
25	2	9094278		1	
25	3	9094278		2	
25	1	9094277		3	
25	2	9094277		3	
25	3	9094277		3	x
25	1	9092246		2	
25	2	9092246		2	
25	3	9092246		3	
		<b>ROW 26</b>			
26	1	9094318		2	
26	2	9094318		2	
26	3	9094318		2	
26	1	9094305		2	x
26	2	9094305		2	x
26	3	9094305		2	x
26	1	9094295		2	
26	2	9094295		1	
26	3	9094295		1	
26	1	9094274		2	
26	2	9094274		2	
26	3	9094274		2	
26	1	9094297		1	
26	2	9094297		1	
26	3	9094297		1	
26	1	9094268		2	
26	2	9094268		2	
26	3	9094268		3	
26	1	9094319		3	
26	2	9094319		3	
26	3	9094319		1	
26	1	9094299		2	
26	2	9094299		2	x
26	3	9094299		2	x
26	1	9094307	x	1	
26	2	9094307	x	1	
26	3	9094307		2	
		<b>ROW 27</b>			
27	1	9092254		1	
27	2	9092254	x	1	
27	3	9092254	x	1	
27	1	9094300		3	
27	2	9094300		3	x
27	3	9094300		3	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Height rating 1=tall 3=short	2010 HV turf/short preselect
27	1	Cuivre		2	
27	2	Cuivre		2	
27	3	Cuivre		2	
27	1	9094265		2	
27	2	9094265		1	
27	3	9094265		1	
27	1	9094264		2	
27	2	9094264		2	x
27	3	9094264		2	
27	1	EWP		1	
27	2	EWP		1	
27	3	EWP		1	
27	1	9094272		2	
27	2	9094272		1	
27	3	9094272		1	
27	1	9092249		2	
27	2	9092249		2	
27	3	9092249		2	
27	1	9094311		2	
27	2	9094311		1	
27	3	9094311		1	
		<b>ROW 28</b>			
28	1	9094270		2	
28	2	9094270		2	
28	3	9094270		2	
28	1	9092252	x	1	
28	2	9092252		1	
28	3	9092252	x	1	
28	1	9094301		1	
28	2	9094301		1	
28	3	9094301		1	
28	1	9094296		2	
28	2	9094296		2	
28	3	9094296		2	
28	1	9094269		1	
28	2	9094269		2	
28	3	9094269		2	
28	1	9094290		2	x
28	2	9094290		1	
28	3	9094290		2	

**Table VW-3. Breeder population selected from initial assembly of Virginia wildrye**

Acc.	State	County	# plants	Acc.	State	County	# plants	Acc.	State	County	# plants
9092247	MN	Clay	9	9092257	SD	Beadle	9	9092245	ND	Richland	1
9092250	MN	Aitkin	9	9094263	SD	Clay	4	9092246	ND	Cass	3
9092251	MN	Mille Lacs	9	9094264	SD	Clay	6	9092249	ND	Morton	9
9092253	MN	Aitkin	9	9094265	SD	Yankton	9	9092252	ND	Walsh	6
9092254	MN	Sherburne	9	9094266	SD	Union	7	9092259	ND	Emmons	8
9092255	MN	Sherburne	9	9094273	SD	Hanson	8	9092260	ND	Logan	7
9092256	MN	Aitkin	8	9094274	SD	Dewey	3	9094262	ND	Morton	8
9094261	MN	Rice	9	9094286	SD	Corson	9	9094267	ND	Oliver	8
9094277	MN	Polk	5	9094287	SD	Jackson	3	9094268	ND	Mercer	9
9094283	MN	Marshall	9	9094288	SD	Custer	7	9094269	ND	Mercer	9
9094284	MN	Marshall	9	9094289	SD	Harding	7	9094270	ND	Dunn	8
9094285	MN	Red Lake	3	9094290	SD	Shannon	8	9094271	ND	Stark	9
9094300	MN	Douglas	10	9094291	SD	Mellette	7	9094275	ND	Kidder	9
9094301	MN	Wadena	9	9094292	SD	Perkins	8	9094276	ND	Griggs	9
9094302	MN	Beltrami	9	9094293	SD	Fall River	9	9094278	ND	Nelson	9
9094303	MN	Norman	6	9094294	SD	Stanley	8	9094309	ND	McHenry	4
9094307	MN	Carlton	9	9094295	SD	Butte	9	9094310	ND	McLean	9
9094311	MN	Yellow Medicine	9	9094296	SD	Lawrence	9	9094323	ND	McKenzie	9
9094312	MN	LacQuiParle	8	9094297	SD	Roberts	8	9094324	ND	Golden V	9
9094313	MN	Sherburne	9	9094298	SD	Roberts	9	9094325	ND	Burleigh	9
9094316	MN	Pipestone	9	9094299	SD	Big Stone	2	9094327	ND	Renville	8
9094317	MN	Murray	2	9094304	SD	Hutchinson	2	9094328	ND	Bottineau	9
9094318	MN	Cottonwood	9	9094305	SD	Hand	4	9094329	ND	Mountrail	6
9094319	MN	Redwood	9	9094308	SD	Grant	1	9094330	ND	Ward	2
9094320	MN	Lyon	6	9094314	SD	Brookings	6	EWP	ND		9
9094321	MN	Lincoln	8	9094315	SD	Minnehaha	6				
9094326	MN	Lac Qui Parle	9	9094322	SD	Marshall	3	Cuivre	MI		4

**ACTIVE STUDIES - TECHNICAL REPORT 2013**

Study No. NDPMC-S-0704-CR

Study Name: Theodore Roosevelt National Park

Introduction: The National Park Service (NPS) has a need to preserve the native plant resources and revegetate disturbed park lands. The NPS requires that restoration of native plants will be accomplished using germplasm from populations as closely related genetically and ecologically as possible to the park populations. Quantities of native seed are needed to revegetate areas disturbed by construction activities for the proposed road rehabilitation project. The NPS has requested assistance from the Bismarck Plant Materials Center (PMC). The PMC has agreed to increase seed of six selected grass species collected at Theodore Roosevelt National Park. Technical assistance for planting, growing and cleaning of seed will also be provided to the park. The original interagency agreement was signed in May 2007, and expired in FY 2010. A new 2-year agreement was signed for the years covering FY 2011 and FY2012. A new agreement was signed adding 2013 and later amended to add 2014 to the contract period.

**Targeted Species and Amounts:**

Species	Common name	PLS pounds
<i>Nassella viridula</i>	green needlegrass	240
<i>Pascopyrum smithii</i>	western wheatgrass	550
<i>Elymus trachycaulus</i>	slender wheatgrass	260
<i>Bouteloua curtipendula</i>	sideoats grama	220
<i>Bouteloua gracilis</i>	blue grama	54
<i>Koeleria macrantha</i>	prairie junegrass	29

Accomplishments

2007: Seed was collected throughout the summer and fall by park staff. On July 26, 2007, Theodore Roosevelt National Park staff along with staff from the Natural Resources Conservation Service spent a day collecting seed at the park. Each of the species collected was assigned an accession number by PMC staff for identification and tracking purposes. Seed was cleaned by staff at the Bismarck PMC and samples were tested for purity and germination by the North Dakota State Seed Testing Laboratory located at Fargo, North Dakota. This seed was used to establish seed production fields at the PMC.

The green needlegrass was dormant planted on November 30, 2007. All other species were seeded in the spring of 2008. Following are details related to seed increase for each grass species. See Figure TR-1 for the field location map.

**Seed Production and Distribution:**

Accession Number	Species	Date Planted	Field Size (ac)	2013		Seed Distribution to Park in 2013 (PLS lb)	Inventory Remaining (PLS lb)
				Seed Production (PLS lb)	Seed Harvest Date		
9092171	Green needlegrass	11/30/2007	0	-----field removed-----		0	342
9092172	Western wheatgrass	5/1/2008	0.57	204	7/30/2013	0	245
9092175	Slender wheatgrass	5/1/2008	0	-----field removed-----		0	576
9092173	Blue grama	6/10/2008	0.3	135	8/20/2013	0	178
9092174	Sideoats grama	6/10/2008	0.3	146	8/17/2013	0	197
9092176	Prairie junegrass*	5/22/2008	0.2	173 grams	7/29/2013	0	9

**Green needlegrass: accession 9092171**

Collected seed: Dirty weight: 4.4 lbs; bulk weight after cleaning: 2.8 lbs.

Seed cleaning: Debearder and a two-screen office fanning mill. The debearder speed was 160 rpm for 15 minutes. The office mill screen sizes were #9 round on top and a 1/22 bottom screen, with air ½ open.

Seed quality: Purity: 92%; Germination: 2%; Dormancy: 72%.

Seeding date: November 30, 2007. Due to high seed dormancy, seed was planted in late fall.

Site preparation: The field was cultivated and packed. No pre-plant herbicides were used. Field conditions were good with a firm seedbed. Soil moisture was dry at the surface and frozen below the 3-inch depth. Air temperatures were in the teens at the time of seeding.

Seeding: Seeding rate was approximately 50 seeds (bulk)/linear foot. Fourteen rows, approximately 424 feet long were planted on 42-inch row spacing (0.49 acre). A modified Truax grass drill was used for the planting. The seed was planted at a depth of 1/2 inch. The field received approximately 2 to 3 inches of snow cover a day after planting. The planting is located in panel G-4 on the southwest side.

Maintenance:

2008: The field was sprayed for weeds using Buctril™ herbicide at a rate of 2.0 pints per acre on June 19. Sterling™ herbicide at the rate of 1 pint per acre was applied to the field on June 27 and July 11. The field was hand rogued to remove weeds throughout the summer and irrigation water was applied. The field was fertilized on September 22, using 46-0-0 urea at a rate of 90 pounds of actual N per acre. A fall pre-emergent application of Trust™ herbicide was applied on October 9, at a rate of 1.5 pints per acre. The Trust™ herbicide was incorporated the same day using a 2-row tiller.

2009: The field was sprayed on May 9 with Curtail herbicide at a rate of 2 pints per acre. May 11, the field was walked and hand weeded. On June 4, the field was spot sprayed targeting Canada thistle. The field was sprayed with 2, 4-D herbicide at a rate of 2 pints per acre on August 4. The field was fertilized on September 17 with 46-0-0 urea at a rate of 44.5 pounds of actual N per acre. Curtail herbicide was applied on September 24, at a rate of 2 pints per acre.

2010: The field was sprayed with Trust™ herbicide on April 21 at a rate of 4 pints per acre. Curtail herbicide was applied on May 14 at a rate of 2 pints per acre for broadleaf weed control. The field was hand weeded on May 17. Sterling Blue herbicide was applied on August 25 at a rate of 2 pints per acre for fall broadleaf weed control. A fall pre-emergence herbicide application of Trust was applied in September 21 at 4 pints per acre. Fifty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 4. The field was not irrigated in 2010.

2011: The field was fertilized with 40 pounds of actual N per acre on April 28. On May 18 two pints of Curtail herbicide per acre and 2 pints of Class Act surfactant per acre were applied. The field was hand weeded on June 3. The field was harvested on July 7. On August 30 and September 29 the field was tilled between the rows. Fertilizer was applied on October 19 at a rate of 40 pounds of Actual N per acre in using 46-0-0 urea. On November 4 the field was sprayed with Trust herbicide using 4 pints per acre.

2012: Seed production goals were met in 2011. The field was removed on May 10 with the application of glyphosate.

Plant Performance:

2008: Seedlings were slow to emerge. A fair stand was present by mid-summer. Weed pressure was a problem during the summer and herbicide applications were necessary. Seed continued to germinate and the stand improved by late summer.

2009: The field established well and a good stand was evident at the end of the growing season.

2010: The stand has become well established and seed production should be good for the next few years.

2011: A good stand.

2012: Field removed.

Harvest and cleaning:

2008: No seed was harvested in 2008.

2009: Seed was straight combined on July 2 using a Massey Ferguson model 17 combine. The combine cylinder speed was set at 1200 rpm, cylinder clearance was 7 millimeters and the fan wind speed set on 4 (mostly closed) with a wind board adjustment of 2 (placing air flow on the front of the sieve). The chaffer sieve was ½ inch open and the finishing sieve was set using the medium hole. The combine was operated at 1 mph. The bulk dirty weight of the seed was 94 pounds. The seed was cleaned using a debearder and fanning mill. The seed was debearded for 15 minutes at 235 rpm to break up and remove awns. The seed was then run through a 3-screen model 334 Clipper Fanning Mill using a number 9 screen size for the first screen, a number 8 screen size for the second screen and a 1/22 screen size for the third screen. The air speed was 225 rpm and the side plate setting

was open. The seed was run through the fanning mill twice resulting in 64 bulk clean pounds. The seed was sent in for seed tests and test results showed 99.99% purity, 7% germination and 80% dormant seed. The total clean seed amount was 55.7 pounds PLS.

2010: Seed was straight combined on July 1 using a Massey Ferguson model 17 combine. Combine settings were set the same as in 2009. The bulk dirty weight of the harvested seed was 253 pounds. The seed was cleaned using the same cleaning protocol as in 2009. The clean seed amount was 218 bulk clean pounds. Seed was sent in for tests resulting in 98.73% purity, 13% germination and 80% dormant seed. Pure live seed total was 200.2 pounds.

2011: The field was harvested on July 7. A MF 17 combine was used to straight combine the field. The cylinder speed was set at 1200 rpms and cylinder clearance of 7 mm. Fan wind speed was set on 2 and the fan board adjustment was 4. The finishing sieve was set ½ inch open. The seed was cleaned using a debearder and fanning mill. The seed was debearded for 15 minutes at 235 rpm to break up and remove awns. The seed was then run through a 3-screen model 334 Clipper Fanning Mill using a number 9 screen size for the first screen, a number 8 screen size for the second screen and a 1/22 screen size for the third screen. The air speed was 225 rpm and the side plate setting was open. The seed was run through the fanning mill twice. The clean seed amount was 193 PLS pounds.

2012: No harvest.

### **Western wheatgrass: accession 9092172**

Collected seed: Dirty weight: 17.68 lbs; bulk weight after cleaning: 3.25 lbs.

Seed cleaning: Hammermill and a two-screen office fanning mill. The material was hammermilled twice to break the seed from the stem. A ¼-inch screen was used the first run and a 3/16-inch screen was used for the second run. The office mill screen sizes were 1/12 x 1/2 on top and a blank screen on the bottom for the first run. The second run used a 1/14 x 1/4 screen on top and a blank on the bottom. The side plate setting was ¼ open on both runs.

Seed quality: Purity: 92.24%; Germination: 87%; Dormancy: 0%.

Seeding date: May 1, 2008.

Site preparation: The seedbed was prepared by cultivating twice with a 6-foot S-tine cultivator and packing twice with a Brillion packer.

Seeding: A seeding rate of 40 PLS per linear foot was used for planting the field. Eight rows, approximately 894 feet long, were planted using a modified Truax grass drill with 42-inch row spacing (.57 acre). The seed was planted at a depth of ½ inch. The field is located in panel G-4 of the PMC.

### Maintenance:

2008: The field was sprayed for weeds using Buctril™ herbicide at a rate of 1.5 pints per acre on June 10. Sterling™ herbicide at the rate of 1 pint per acre was applied to the field on June 27, and again on July 11. The field was hand rogued to remove weeds throughout the summer and irrigation water was applied. The field was fertilized on September 22, using 46-0-0 urea at a rate of 90 pounds of actual N per acre. A fall pre-emergent application of Trust™ herbicide was applied on October 9, at a rate of 1.5 pints per acre. The field was lightly tilled the same day using a 2-row tiller to incorporate the Trust™ herbicide.

2009: The field was sprayed on May 7 with Curtail herbicide at a rate of 2 pints/acre. The field was hand weeded on May 11 and 28. On August 14, the field was sprayed with 2 pints/acre of 2,4-D herbicide. On September 17, urea fertilizer was applied at a rate of 44.5 pounds of actual N/acre. On September 24, Curtail herbicide was applied at a rate of 2 pints/acre for broadleaf weed control.

2010: The field was sprayed with Trust™ herbicide on April 21 at a rate of 4 pints per acre. The field was hand weeded on May 17. A fall pre-emergence herbicide application of Trust was applied in September 21 at 4 pints per acre. Fifty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 4. The field was not irrigated in 2010.

2011: The field was fertilized with 40 pounds of actual N per acre on April 29. On May 18 two pints of Curtail herbicide per acre and 2 pints of Class Act surfactant per acre were applied. The field was harvested on August 3. Fertilizer was applied on October 19 at a rate of 40 pounds of Actual N per acre in using 46-0-0 urea. On November 4 the field was sprayed with Trust herbicide using a rate of 4 pints per acre.

2012: The field was fertilized with 40 pounds of actual N per acre on April 25. On April 26 Prowl herbicide was applied at 3 quarts per acre. The field was harvested on July 19. On October 2, Trust herbicide was applied at 4 quarts per acre

2013: The field was fertilized with 50 actual pounds of N per acre with 46-0-0 urea. No herbicides were applied.

### Plant performance:

2008: The seedlings emerged very well and a good stand was established by mid-summer.

2009: Excellent growth that produced a large amount of biomass. A fair seed crop appeared to be developing by mid-summer but poor seed fill was apparent during harvest and a fair seed crop resulted. The field is a mix of western wheatgrass and slender wheatgrass. This mixture was due to both species being collected together in the initial park collection and planted to establish the seed increase field at the PMC. The mixture has been discussed among both parties and it was decided to maintain the field as a mix.

2010: The stand is well established and plant vigor remains high.

2011: The field has grown solid and seed production is declining.

2012: Seed production has declined and a new field should be started if the agreement continues.

2013: Field is grown solid but seed production in 2013 was relatively good.

#### Harvest and cleaning:

2008: No seed was harvested in 2008.

2009: Seed was straight combined with a Massey Ferguson model 17 on July 28. The stand was mostly lodged and made combining difficult. The combine was set with a cylinder speed of 950 rpm. A cylinder clearance of 7 millimeters, a fan wind speed of 1(closed) and a wind board adjustment of 4 (wind placed near the front of sieve). The chaffer sieve adjustment was ½ inch open and a medium hole finishing sieve was used. The combine was operated at 1 mile per hour. The bulk dirty weight of the seed was 344 pounds. The seed was cleaned through a 3 screen Model 334 Clipper Fanning Mill using a 1/14x1/2 screen size for the first screen, a 1/16 x ¼ screen for the second and a 9 triangle for the third screen. The 9 triangle screen was covered with plastic except for the bottom 3-inches of the screen. The air speed was 258 rpm with the side plate open. The seed was run a second time through the fanning mill using the same settings. The bulk clean seed amount was 87 total pounds. The field has a percentage of slender wheatgrass mixed in with the western wheatgrass. The slender was misidentified during collection and included in the western wheatgrass seed. It was decided to leave the field as a mixture and harvest accordingly. The seed was sent in for seed tests and test results showed western wheatgrass with a 65.86 % purity, 59% germination and 0% dormant. The slender wheatgrass has 25.46% purity, 96% germination and 0% dormant seed. The total clean seed amount was 33.8 pounds PLS of western wheatgrass and 21.2 pounds PLS of slender wheatgrass. The total western/slender wheatgrass mix is 55 pounds PLS.

2010: Seed was straight combined on August 4 using a Massey Ferguson model 17 combine. Combine settings were set the same as in 2009. The bulk dirty weight of the harvested seed was 316 pounds. The seed was cleaned using a Clipper 29D four screen fanning mill. The clean seed amount was 121 bulk pounds. Seed was sent in for analysis resulting in 92.70% purity, 94% germination and 0% dormant seed. Pure live seed total was 105.4 pounds.

2011: The field was straight combined on August 3 using a MF 17 combine. The combine was set with a cylinder speed of 1000 rpm. A cylinder clearance of 8 millimeters, a fan wind speed of 1(closed) and a wind board adjustment of 4 (wind placed near the front of sieve). The chaffer sieve adjustment was ½ inch open and a medium hole finishing sieve was used. The combine was operated at 1 mile per hour. The seed was cleaned through a 4 screen Clipper Fanning Mill using a 1/13x1/2 screen size for the first screen, a 1/14 x ½ screen for the second screen, a 1/14x ¼ screen for the third and a 9 triangle for the third screen. The 9 triangle screen was covered with plastic except for the bottom 2-inches of the screen. The air speed was 232 rpm. The top door was set with a 4 inch opening. The shaker speed was 400 rpm. The seed was run a second time through the fanning mill using the same settings. The clean seed amount was 156.48 PLS pounds.

2012: The field was straight combined on August 19 using a MF 17 combine. The combine was set with a cylinder speed of 1000 rpm. A cylinder clearance of 8 millimeters, a fan wind speed of 1(closed) and a wind board adjustment of 4 (wind placed near the front of sieve). The chaffer sieve adjustment was ½ inch open and a medium hole finishing sieve was used. The combine was operated at 1 mile per hour. The seed was cleaned through a 3 screen Clipper Fanning Mill using a 11 screen size for the first screen, a 1/14 x ½ screen for the second screen, a 9 triangle for the third screen. The 9-triangle screen was covered with plastic except for the bottom 1-inch of the screen. The air speed was 243 rpm. The side plate was open. The clean seed amount was 25.44 PLS pounds.

2013: The field was straight combined using a MF 17 combine on July 30. Seed was cleaned and tested resulting in 204 PLS pounds.

#### **Slender wheatgrass: accession 9092175**

Collected seed: Dirty weight: 3.59 lbs; bulk weight after cleaning: 854 grams.

Seed cleaning: Hammermill and two-screen office fanning mill. The seed was initially hammermilled twice to separate seed from the stems. A ¼-inch screen size and a slow speed were used. The material was fed at full rate.

The seed was then run twice through an office mill. The first run used a number 12 screen size for the top screen and a blank screen was used on the bottom. A number 10 screen size was used as the top screen with a blank screen being used on the bottom for the second run. The side plate setting on the office mill was ¼ open for both runs.

Seed quality: Purity: 98.19%; Germination: 89%; Dormancy: 0%.

Seeding date: May 1, 2008.

Site preparation: The seedbed was prepared by working twice with a 6-foot S-tine cultivator and packing twice with a Brillion packer.

Seeding: Seed was planted at a rate of 33 PLS per linear foot and a depth of ½ inch. Fourteen rows, approximately 443 feet long, were planted using a modified Truax grass drill with 42-inch row spacing (.50 acre). The field is located in panel G-4 of the PMC.

Maintenance:

2008: The field was sprayed for weeds using Buctril™ herbicide at a rate of 1.5 pints per acre on June 10. Sterling™ herbicide at the rate of 1 pint per acre was applied to the field on June 27, and again on July 11. The field was hand rogued to remove weeds throughout the summer and irrigation water was applied. The field was fertilized on September 22, using 46-0-0 urea at a rate of 90 pounds of actual N per acre. A fall pre-emergent application of Trust™ herbicide was applied on October 9, at a rate of 1.5 pints per acre. The Trust™ herbicide was incorporated the same day using a 2-row tiller.

2009: The field was sprayed on May 7 with Curtail herbicide at a rate of 2 pints/acre. The field was hand weeded on May 11. The field was walked and spot sprayed for Canada thistle on June 4. On August 14, the field was sprayed with 2,4-D herbicide at a rate of 2 pints per acre. On September 17, urea fertilizer was applied at a rate of 44.5 pounds of actual N/acre. On September 24, Curtail herbicide was applied at a rate of 2 pints/acre for broadleaf weed control.

2010: The field was sprayed with Trust™ herbicide on April 21 at a rate of 4 pints per acre. The field was hand weeded on May 17. Sterling Blue herbicide was applied on August 25 at a rate of 2 pints per acre to control broadleaf weeds. A fall pre-emergent herbicide application of Trust was applied in September 21 at 4 pints per acre. Fifty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 4. The field was not irrigated in 2010.

2011: The field was fertilized with 40 pounds of actual N per acre on April 28. Weeds were spot sprayed on May 2. On May 18 two pints of Curtail herbicide per acre and 2 pints of Class Act surfactant per acre were applied. The field was harvested on July 26. On August 29 and September 26 the field was rototilled between rows. Fertilizer was applied on October 19 at a rate of 40 pounds of Actual N per acre in using 46-0-0 urea. On November 4 the field was sprayed with Trust herbicide using a rate of 4 pints per acre.

2012: Seed production goals were met in 2011. The field was sprayed with glyphosate on May 10 to kill the field.

Plant performance:

2008: The seedlings emerged very well and a good stand was established by mid-summer.

2009: The stand is well established and produced a large amount of biomass and seed. It was observed that a majority of the field contained slender wheatgrass with a percentage of the stand being made up of thickspike wheatgrass. This mixture was most likely the result of the two species being collected together during the initial park collection. It was discussed and agreed to manage the field as a mixture of thickspike wheatgrass and slender wheatgrass.

2010: The field is well established.

2011: Good stand.

2012: Field removed.

Harvest and cleaning:

2008: No seed was harvested in 2008.

2009: The field was straight combined on July 22 using a Massey Ferguson model 17 combine. The cylinder speed was set at 950 rpm with a 7 millimeter cylinder clearance. The fan wind speed was set on the first hole setting (closed) and the fan wind board was set on the 4<sup>th</sup> hole setting (wind directed to the front of the sieve). The chaffer sieve was set at ½ inch open and medium hole finishing sieve was used. The combine was operated at 1 mile per hour. The bulk dirty weight of the seed was 365 pounds. The seed was cleaned through a 3-screen Model 334 Clipper Fanning Mill using a #13 screen for the first screen, a number 11 for the second, and a 9-triangle screen that was covered with plastic sheeting except for the bottom 3 inches which were left open for the third screen. The air speed was run at 300 rpm with the side plate open. The seed was run a second time through the fanning mill using a #11 for the first screen, a #10 for the second screen, and a 9-triangle with 3-inch opening for the third screen the air speed was increased to 340 rpm. The bulk clean seed amount was 229

pounds. The seed was sent in for analysis and test results showed 92.82% purity, 98% germination and 0% dormant seed for the thickspike wheatgrass and 5.57% purity, 97% germination and 0% dormant seed for the slender wheatgrass. The total clean seed amount was 208.3 pounds PLS of thickspike wheatgrass and 12.4 pounds of slender wheatgrass. The total thickspike/slender mix was 220.7 pounds PLS.

2010: The field was straight combined on July 22 using a Massey Ferguson model 17 combine. The cylinder speed was set at 1000 rpm with a 7 millimeter cylinder clearance. The fan wind speed was set on the first hole setting (closed) and the fan wind board was set on the 4<sup>th</sup> hole setting (wind directed to the front of the sieve). The chaffer sieve was set at ½-inch open and medium hole finishing sieve was used. The combine was operated at 1 mile per hour. The bulk dirty weight of the seed was 429 pounds. The seed was cleaned through a 3-screen Model 334 Clipper Fanning Mill. The bulk clean seed amount was 341 pounds. The seed was sent in for analysis and test results showed 94.55% purity, 95% germination and 0% dormant seed. The total clean seed was 306.3 pounds PLS.

2011: The field was straight combined on July 26 using a Massey Ferguson model 17 combine. The cylinder speed was set at 1000 rpm with a 7 millimeter cylinder clearance. The fan wind speed was set on the first hole setting (closed) and the fan wind board was set on the 4<sup>th</sup> hole setting (wind directed to the front of the sieve). The chaffer sieve was set at ½-inch open and medium hole finishing sieve was used. The combine was operated at 1 mile per hour. The seed was cleaned through a 3-screen Model 334 Clipper Fanning Mill. The total clean seed was 222 pounds PLS.

2012: No harvest. Field was removed.

### **Blue grama: accession 9092173**

Collected seed: Dirty weight - 1.4 lbs; bulk after cleaning: 188.1 grams.

Seed cleaning: Debearder and two-screen office fanning mill. The seed was processed through a debearder for 10 minutes before being run through a small office mill. The top screen was a number 10 and the bottom screen was a blank. The seed was then hand screened to remove the larger sticks. A sample was sent to the seed testing lab for germination and purity results.

Seed quality: Purity: 35.72%; Germination: 78%; Dormancy: 1%.

Seeding date: June 10, 2008.

Site preparation: The seedbed was prepared by working twice with a 6-foot S-tine cultivator and packing twice with a Brillion packer.

Seeding: Seed was planted at a rate of 40 PLS per linear foot and a depth of ½ inch. Due to the limited seed amount of blue grama, a plot drill was used to plant a 6-foot x 158-foot bed (0.02 acres) in panel G-4 of the PMC. The seed was planted at a depth of ½ inch.

### Maintenance:

2008: Sterling™ herbicide at the rate of 1 pint per acre was applied to the field on June 27. The field was hand rogued to remove weeds throughout the summer and irrigation water was applied. The field was not fertilized in 2008.

2009: The field was sprayed on May 7 with Curtail herbicide at a rate of 2 pints per acre. The field was fertilized with 46-0-0 urea at a rate of 44.5 pounds of actual N on May 7. The field was hand weeded throughout the summer. A fall application of 46-0-0 urea fertilizer was applied on September 17 at a rate of 44.5 pounds of actual N. On September 24, the field was sprayed with Curtail herbicide at a rate of 2 pints per acre.

2010: The field was sprayed with Trust™ herbicide on April 21 at a rate of 4 pints per acre. The field was hand weeded on May 17. 2,4D herbicide was applied on June 9 at a rate of 2 pints per acre to control broadleaf weeds. Fifty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 4. The field was not irrigated in 2010.

2011: The field was burned on April 13 to remove residue and promote seed production. On April 26 Atrazine was applied at a 2 pint per acre rate. The field was spot sprayed on May 2. Forty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 2. On May 18 the field was sprayed with Curtail herbicide at a rate of 2 pints per acre and Class Act surfactant at 2 pints per acre for broadleaf weed control. The field was harvested on August 25. The field was not irrigated in 2011.

2012: The field was burned on April 25. On May 1, 40 pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 1. Atrazine was applied at 2 pints per acre on May 1. The field size was increased from 0.03 acre to 0.3 acre on May 9. On June 15, Sterling Blue herbicide was applied to the new field at a rate of 1 pint per acre. The new field was hand weeded on July 4 and mowed on July 16 for weed control. The old field was harvested on August 7. The new field produced seed also and was harvested later that fall. The field

was fertilized with 40 pounds actual nitrogen on September 28. The field was irrigated with ½ inch of water in 2012.

2013: The field was burned on May 2 to remove residue. A pre-emergent herbicide was applied on May 6. On May 14, 58 pounds of actual nitrogen were applied as 46-0-0 urea. Broadleaf weeds were sprayed on June 6 with Curtail herbicide.

Plant performance:

2008: The seedlings were slow to establish and a fair stand was observed by the end of the summer.

2009: The stand developed very well in 2009 and a solid stand was achieved by the end of the growing season.

2010: A good stand with high plant vigor.

2011: The stand is well established.

2012: The existing field continues to do well. A new field was planted on May 9. This seeding established well. Viable seed was produced in the first year of the planting and a harvest was made.

2013: Excellent field establishment.

Harvest and cleaning:

2008: A few plants produced mature seed and were hand stripped by PMC staff. Three pounds of dirty seed were harvested, amounting to 1.5 pounds after cleaning. The seed will be bulked together with the 2009 harvest and tested at that time.

2009: Seed was straight combined with a Wintersteiger plot combine on August 27. The combine was set with a cylinder speed of 700 rpm, cylinder clearance was set with the front adjustment at 1 millimeter and the back adjustment was set at 2 millimeters. The fan wind speed was set at 650 rpm and the fan door was closed. The large-hole chaffer sieve was used and the adjustable grain sieve was set ¼ inch open. The bulk dirty weight of the seed was 13 pounds. The seed was run through a debarker for 10 minutes and then run through an office mill. A number 10 screen was used for the first screen and a blank for the second screen. The seed was run a second time through the office mill using the same settings. The bulk clean seed amount was 6 pounds. The seed was bulked with the 1.5 pounds of 2008 harvest and sent in for seed tests. The test results are a 94.65% purity, 90 % germination, and 0% dormant seed. The total clean seed amount (2008 and 2009) was 6.4 lbs PLS.

2010: Seed was straight combined with a Wintersteiger plot combine on August 27. The combine was set with a cylinder speed of 650 rpm, cylinder clearance was set with the front adjustment at 1 millimeter and the back adjustment was set at 2 millimeters. The fan wind speed was set at 650 rpm and the fan door was closed. The large-hole chaffer sieve was used and the adjustable grain sieve was set ¼ inch open. The bulk dirty weight of the seed was 22 pounds. The seed was run through a debarker for 10 minutes and then run through an office mill. The bulk clean seed amount was 5.5 pounds. The seed was sent in for seed tests resulting in a purity of 56.01%, germination of 64% and 0% dormant seed. The total clean seed amount was 2 pounds PLS.

2011: The field was straight combined on August 25 using a MF-17 combine. The combine was set with a cylinder speed of 1200 rpm, cylinder clearance was set at 8mm. The fan wind speed was set at 1 fan door was closed. The medium hole chaffer sieve was used and the adjustable grain sieve was set ¼ inch open. The seed was run through a debarker for 10 minutes and then run through an office mill. The clean seed amount was 7.42 PLS pounds.

2012: The field was straight combined with a Wintersteiger plot combine on August 22. The combine was set with a cylinder speed of 1200 rpm, cylinder clearance was set with the front adjustment at 1 millimeter and the back adjustment was set at 1 millimeter. The fan wind speed was set at 680 rpm and the fan door was closed. The large-hole chaffer sieve was used and the adjustable grain sieve was set 1/2 inch open. The seed was run through a debarker for 10 minutes at 292 rpm. It was then run through a 4-screen Clipper 29D fanning mill using a #12 screen for the first screen, #11 for the second screen, #8 with ½ inch open for the third and a #9 tri with a 1-inch opening for the fourth screen the air speed was 157 rpm. And the shaker speed was 400 rpm. The top door was open. The seed was then run through a cylinder indent cleaner with a feeder speed of 30, cylinder speed of 50 and a number 3 indent cylinder. The total clean seed amount was 29.43 pounds PLS.

2013: The field was harvested by straight combining with a Wintersteiger plot combine on August 20. Seed was cleaned and tested resulting in 135 PLS pounds.

**Sideoats grama: accession 9092174**

Collected seed: Dirty weight: 3.6 lbs; bulk after cleaning: 2.8 lbs.

Seed cleaning: Two-screen office fanning mill. The top screen was a #20 screen size and the bottom screen was a blank. The side plate air setting ¼ open. A sample of the seed was tested for purity and germination.

Seed quality: Purity: 61.62%; Germination: 5%; Dormancy: 24%.

Seeding date: June 10, 2008.

Site preparation: The seedbed was prepared by working twice with a 6-foot S-tine cultivator and packing twice with a Brillion packer.

Seeding: Seed was planted at a rate of 30 PLS per linear foot and a depth of ½ inch. Due to the limited seed amount of sideoats grama, a plot drill was used to plant a 6-foot x 189-foot bed (0.03 acres) in panel G-4 of the PMC.

Maintenance:

2008: Sterling™ herbicide was applied on June 27, at the rate of 1 pint per acre. The field was hand rogued to remove weeds throughout the summer and irrigation water was applied. The field was not fertilized in 2008.

2009: The field was hand weeded throughout the summer. Urea fertilizer (46-0-0) was applied at a rate of 44.5 pounds of actual N on September 17. The field was sprayed with 2 pints per acre of Curtail herbicide on September 24.

2010: The field was sprayed with Trust™ herbicide on April 21 at a rate of 4 pints per acre. The field was hand weeded on May 17. 2,4D herbicide was applied on June 9 at a rate of 2 pints per acre to control broadleaf weeds. Fifty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 4. The field was not irrigated in 2010.

2011: The field was burned on April 13 to remove residue and promote seed production. On April 26, atrazine was applied at 2 pints per acre. The field was spot sprayed on May 2. Forty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 2. On May 18, the field was sprayed with Curtail herbicide at a rate of 2 pints per acre and Class Act surfactant at 2 pints per acre for broadleaf weed control. The field was harvested on August 17. The field was not irrigated in 2011.

2012: The field was burned on April 25. Forty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 1. Atrazine was applied at a 2 pint per acre rate on May 1. The field size was increased from 0.02 acres to 0.3 acres on May 9. On June 15 Sterling Blue herbicide was applied to the new field at a rate of 2 pints per acre. The new field was mowed on July 10. The old field was harvested on August 7. The new field produced seed also and was harvested later that fall. The field was irrigated with ½ inch of water on August 24.

2013: The field was burned to remove residue on May 4. A pre-emergent herbicide was applied on May 6. Fifty-eight pounds of actual nitrogen was applied using 46-0-0 urea on May 14. The field was sprayed on June 6 to control broadleaf weeds with Curtail herbicide.

Plant performance:

2008: The seedlings were slow to establish and a fair stand was observed by the end of the summer. A few of the plants produced seed by the end of the growing season.

2009: The stand was well established by the end of the 2009 growing season.

2010: The field has become well established.

2011: Good stand.

2012: The existing field has a good stand established. The new field established well. Seed was produced and harvested that fall.

2013: Field is excellent.

Harvest and cleaning:

2008: Seed was hand stripped from the plants and produced 4.5 pounds of dirty seed. The seed has been cleaned and 3 pounds of clean seed resulted.

2009: The field was straight combined on September 4 using a Wintersteiger plot combine. The combine was set with a cylinder speed of 850 rpm, cylinder clearance was set with the front adjustment at 1 millimeter and the back adjustment was set at 2 millimeters. The fan wind speed was set at 670 rpm and the fan door was 1 inch open. The large-hole chaffer sieve was used and the adjustable grain sieve was set ¾ inch open. The bulk dirty weight of the seed was 40 pounds. The seed was cleaned through a 3-screen Model 334 Clipper Fanning Mill using a #14 screen for the first screen, #13 for the second, and a 9-triangle screen that was covered with plastic sheeting except for the bottom 3 inches which were left open for the third screen. The air speed was run at 268 rpm with the side plate open. The bulk clean seed amount was 27 pounds. The seed was sent in for tests which resulted in 98.43% purity, 90% germination and 0% dormant seed. The total clean seed amount was 23.9 pounds PLS.

2010: The field was straight combined on September 4 using a Wintersteiger plot combine. The combine was set with a cylinder speed of 850 rpm, cylinder clearance was set with the front adjustment at 1 millimeter and the back adjustment was set at 2 millimeters. The fan wind speed was set at 670 rpm and the fan door was 1 inch open. The large-hole chaffer sieve was used and the adjustable grain sieve was set ¾ inch open. The bulk dirty weight of the seed was 27 pounds. The seed was cleaned through a 3-screen Model 334 Clipper Fanning Mill using a #14 screen for the first screen, a #13 for the second, and a 9-triangle screen that was covered with plastic sheeting except for the bottom 3 inches which were left open for the third screen. The air speed was run at 268

rpm with the side plate open. The bulk clean seed amount was 12 pounds. The seed was sent in for tests which resulted in 96.25% purity, 58% germination and 4% dormant seed. The total clean seed amount was 7.2 pounds PLS.

2011: The field was straight combined on August 17 using a Wintersteiger plot combine. The combine was set with a cylinder speed of 850 rpm, cylinder clearance was set with the front adjustment at 1 millimeter and the back adjustment was set at 1 millimeter. The fan wind speed was set at 670 rpm and the fan door was 1 inch open. The large-hole chaffer sieve was used and the adjustable grain sieve was set  $\frac{3}{4}$  inch open. The seed was cleaned through a 3-screen Model 334 Clipper Fanning Mill using a #14 screen for the first screen, a #13 for the second, and a 9-triangle screen that was covered with plastic sheeting except for the bottom 3 inches which were left open for the third screen. The air speed was run at 268 rpm with the side plate open. The total clean seed amount was 7.13 PLS pounds.

2012: The field was straight combined with a Wintersteiger plot combine on August 7. The combine was set with a cylinder speed of 1000 rpm, cylinder clearance was set with the front and back adjustment at 1 millimeter. The fan wind speed was set at 660 rpm and the fan door was  $\frac{1}{2}$  open. The large-hole chaffer sieve was used and the adjustable grain sieve was set  $\frac{1}{2}$  inch open. The seed was cleaned through a 3-screen Model 334 Clipper Fanning Mill using a #14 screen for the first screen, #13 for the second, and a 9-triangle screen that was covered with plastic sheeting except for the bottom 3 inches which were left open for the third screen. The air speed was run at 268 rpm with the side plate open. The total clean seed amount was 34.55 PLS pounds.

2013: The field was harvested straight with a MF 17 combine on August 17. Seed was cleaned and tested resulting in 146 PLS pounds.

#### **Prairie junegrass: accession 9092176**

Collected seed: Dirty weight: 0.98 lbs; bulk weight after cleaning: 56.6 grams.

Seed cleaning: Hammermill and two screen office fanning mill. The materials was hammermilled twice using a 3/32 screen size for both runs and a slow speed at full rate of feed. The seed was run through a two-screen office mill twice using a 1/12 top screen and a blank bottom screen for both runs. The air speed (rpm) was slow and the side plate setting was closed.

Seed quality: No seed tests were done due to the limited amount of seed.

Seeding date: Seedlings were transplanted into the field on May 22, 2008.

Site preparation: The bed was prepared by working twice with a 6-foot S-tine cultivator and packing twice with a Brillion packer. A specialized tool bar with two chisel shovels spaced 42 inches apart was used to make 2 rows for transplanting.

Seeding: Seed was very limited so seed was started in flats in the greenhouse on February 14. Plantlets were transplanted from the flats into cone-tainers when they were approximately  $\frac{1}{2}$  inch tall. The plants were allowed to grow in the greenhouse until May 12, when they were moved to the lathhouse to harden off for transplanting into the field. Approximately 700 plants were transplanted into two 348-foot long rows in panel G-4 of the PMC.

#### Maintenance:

2008: Sterling™ herbicide was applied on June 27 at the rate of 1 pint per acre. The field was hand rogued to remove weeds throughout the summer. Irrigation water was applied on May 23, the day after planting, to water in the transplants and increase the survival. Irrigation water continued to be applied during the growing season. No fertilizer was applied in 2008.

2009: The field was sprayed on May 7 using Curtail herbicide at a rate of 2 pints/acre. Urea fertilizer, 46-0-0 was applied on May 7 at a rate of 44.5 pounds of actual N/acre. The field was roto-tilled on June 2. The field was sprayed on August 14 with 2,4-D herbicide at a rate of 2 pints per acre. On September 17, urea fertilizer, 46-0-0, was applied at a rate of 44.5 pounds of actual N/acre. On September 24, Curtail herbicide was applied at a rate of 2 pints/acre.

2010: The field was sprayed with Trust™ herbicide on April 21 at a rate of 4 pints per acre. The field was hand weeded on May 17. Fifty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 4. The field was not irrigated in 2010.

2011: The field was fertilized with 40 pounds of actual N per acre on April 28. On May 18 two pints of Curtail herbicide per acre and 2 pints of Class Act surfactant per acre were applied. On July 15 the field was hand weeded. The field was harvested on July 22. On August 30 the field was tilled between rows. Fertilizer was applied on October 19 at a rate of 40 pounds of actual N per acre in using 46-0-0 urea. On November 4 the field was sprayed with Trust herbicide using a rate of 4 pints per acre.

2012: The field size was increased from 0.03 acre to 0.2 acre on May 12. On June 15, Sterling Blue at a rate of 1 pint per acre was applied for broadleaf weed control. On July 12, seed was harvested by hand clipping the

seed heads. On July 16, the new field was mowed. Fertilizer was applied on September 28 at a rate of 40 pounds of actual N per acre in using 46-0-0 urea. On November 2, the field was sprayed with Trust herbicide using a rate of 4 quarts per acre.

2013: The field was fertilized with 58 pounds of actual nitrogen using 46-0-0 urea on May 14. No herbicides were applied in 2013.

Plant performance:

2008: Survival of the junegrass plants was excellent.

2009: The small field has become well established.

2010: The field is well established and individual plants are robust.

2011: Plant vigor is declining.

2012: New field is developing slowly due to weed pressure and dry conditions. Old field continues to decline in vigor.

2013: The field has established poorly with very little new established plants.

Harvest and cleaning:

2008: No seed was harvested in 2008.

2009: The field was straight combined on July 17 using a Wintersteiger plot combine. The combine was set with a cylinder speed of 700 rpm, cylinder clearance was set with the front adjustment at 1 millimeter and the back adjustment was set at 1 millimeter. The fan wind speed was set at 600 rpm and the fan door was closed. The large-hole chaffer sieve was used and the adjustable grain sieve was set ½ inch open. The bulk dirty weight of the seed was 46 pounds. The seed was cleaned through a small 2-screen office mill using a #7 screen for the first screen and a blank screen for the second screen. Air speed was slow and the side plate was closed. The seed was run a second time changing the screen sizes to a 1/13 screen for the first and a 1/25 for the second screen. The bulk clean seed amount was 5 pounds. The seed was sent in for tests which resulted in 62.07% purity, 64% germination and 0% dormant seed. The total clean seed amount was 2 pounds PLS.

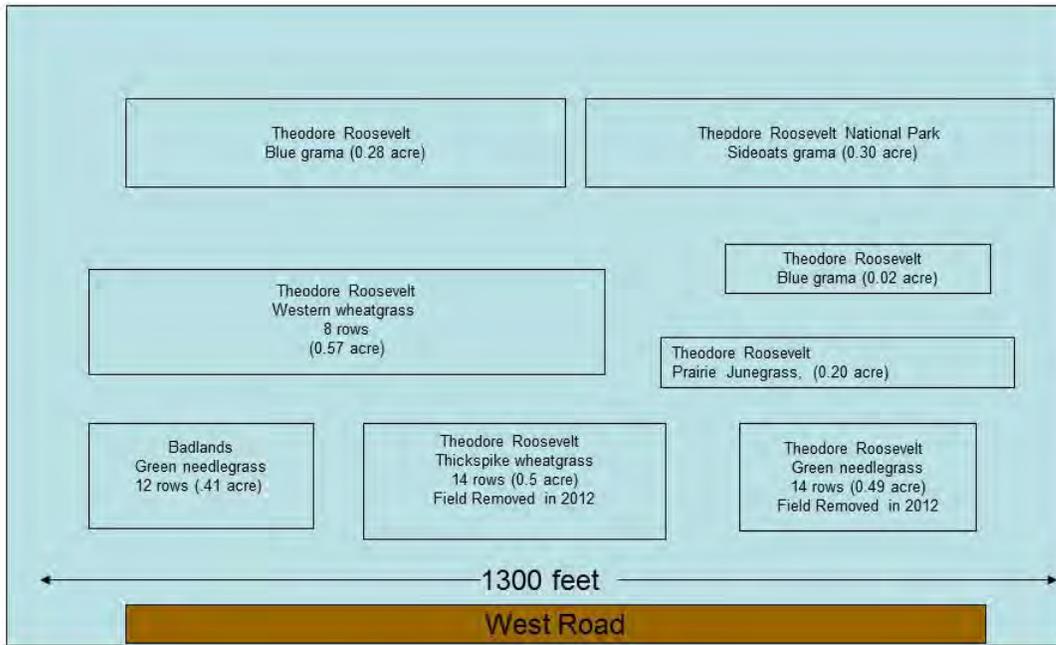
2010: The field was straight combined on July 17 using a Wintersteiger plot combine. The combine was set with a cylinder speed of 915 rpm, cylinder clearance was set with the front adjustment at 1 millimeter and the back adjustment was set at 1 millimeter. The fan wind speed was set at 665 rpm and the fan door was closed. The large-hole chaffer sieve was used and the adjustable grain sieve was set 3/8 inch open. The bulk dirty weight of the seed was 12 pounds. The seed was cleaned through a small 2-screen office mill using a #7 screen for the first screen and a blank screen for the second screen. Air speed was slow and the side plate was closed. The bulk clean seed amount was 7 pounds. The seed was sent in for tests which resulted in 69.22% purity, 70% germination and 0% dormant seed. The total clean seed amount was 3.4 pounds PLS.

2011: The field was straight combined on July 22 using a Wintersteiger plot combine. The combine was set with a cylinder speed of 915 rpm, cylinder clearance was set with the front adjustment at 1 millimeter and the back adjustment was set at 1 millimeter. The fan wind speed was set at 665 rpm and the fan door was closed. The large-hole chaffer sieve was used and the adjustable grain sieve was set 3/8 inch open. The seed was cleaned through a small 2-screen office mill using a #7 screen for the first screen and a blank screen for the second screen. Air speed was slow and the side plate was closed. The total clean seed amount was 1.1 pounds PLS.

2012: The field was harvested by hand due to very few seed heads in the field on July 12. The seed was cleaned through a small 2-screen office mill using a #7 screen for the first screen and a blank screen for the second screen. Air speed was slow and the side plate was closed. The total clean seed amount was 1.06 pounds PLS.

2013: The field was hand harvested cleaned and tested resulting in 173 PLS grams of seed.

Figure TR-1. Field Map, Panel G-4.



## **ACTIVE STUDIES - TECHNICAL REPORT 2013**

Study No. NDPMC-S-0705-CR

Study Name: Badlands National Park

Introduction: The National Park Service (NPS) has a need to preserve the native plant resources and revegetate disturbed park lands. The NPS requires that restoration of native plants will be accomplished using germplasm from populations as closely related genetically and ecologically as possible to the park populations. Quantities of native seed are needed to revegetate areas disturbed by construction activities for the proposed road rehabilitation project. The NPS has requested assistance from the Bismarck Plant Materials Center (PMC). The PMC has agreed to increase seed of five selected grass species collected at Badlands National Park. Technical assistance for planting, growing and cleaning of seed will also be provided to the park. The first interagency agreement was signed in May 2007 and expired in FY 2010. The agreement has been extended and expires the end of FY2013.

### **Targeted Species and Amounts:**

<b>Species</b>	<b>Common name</b>	<b>PLS pounds</b>
<i>Nassella viridula</i>	green needlegrass	300
<i>Pascopyrum smithii</i>	western wheatgrass	600
<i>Elymus trachycaulus</i>	slender wheatgrass	100
<i>Bouteloua gracilis</i>	blue grama	50
<i>Sporobolus cryptandrus</i>	sand dropseed	25

### **Accomplishments**

Seed was collected throughout the summer and fall of 2007 by park staff. On July 24, 2007, Badlands National Park staff along with staff from the Natural Resources Conservation Service spent a day collecting seed at the park. All seed was inventoried at the Bismarck PMC and was cleaned, tested and used in the planting of seed increase fields at the PMC. Each species of seed was assigned an accession number (identification number). Seed germination and purity was tested by the North Dakota State Seed Department. The green needlegrass was dormant planted on November 30, 2007. All of the other species except sand dropseed were seeded in the spring of 2008. Seed from the sand dropseed was planted in the PMC greenhouse in February 2008. Approximately 700 sand dropseed plants were propagated for establishing the seed production field. Following are details related to seed increase activities for each grass species. See Table BA-1 for cumulative information on target species collected at Badlands National Park. See Figure BA-1 and BA-2 for field location maps.

**Table BA-1. Seed Production and Distribution**

Accession Number	Species	Date Planted	Field Size (ac)	2013 Seed Production (PLS lb)	2013 Seed Harvest Date	Seed Distribution to Park in 2013 (PLS lb)	Inventory Remaining (PLS lb)
9092167	Green needlegrass	11/30/2007	0.41	68	7/11/2013	0	459
9092165	Western wheatgrass	5/6/2008	1.5	54	8/1/2013	0	164
9092166	Slender wheatgrass	5/6/2008	-----field removed-----			0	568
9092168	Blue grama	6/10/2008	0.3	98	8/20/2013	0	126
9092169	Sand dropseed	5/22/2008	0.1	10	7/30/2013	0	32

**Green needlegrass: accession 9092167**

Seed cleaning of collected seed: Debearder and a 2-screen office fanning mill. The debearder speed was 160 rpm for 15 minutes. The office mill screen sizes were #9 round on top and a 1/22 bottom screen, with air ½ open.

Seeding date: November 30, 2007. Due to high seed dormancy, seed was planted in late fall.

Site preparation: The field was cultivated and packed. No preplant herbicides were used. Field conditions were good with a firm seedbed. Soil moisture was dry at the surface and frozen below the 3-inch depth. Air temperatures were in the teens at the time of seeding.

Seeding: The field was dormant seeded on November 30, 2007. The seeding rate was approximately 50 seeds (bulk)/linear foot. Twelve rows, approximately 424 feet long, were planted using a modified Truax grass drill with 42-inch row spacing (0.41 acre). The seed was planted at a depth of 1/2 inch. The field received approximately 2 to 3 inches of snow cover the day after planting. The planting is located in panel G-4 on the southwest side.

Maintenance:

2008: On May 27, the field was sprayed for weeds using Buctril™ herbicide at a rate of 1.5 pints per acre. On June 27 and July 11, Sterling™ herbicide at the rate of 1 pint per acre was applied to the field. The field was hand rogued to remove weeds throughout the summer. Irrigation water was applied during the growing season. The field was fertilized on September 22, using 46-0-0 urea at a rate of 90 pounds of actual N per acre. A fall pre-emergent application of Trust™ herbicide was applied on October 9, at a rate of 1.5 pints per acre. The field was then lightly tilled the same day using a 2-row tiller to incorporate the Trust™ herbicide.

2009: The field was sprayed on May 7 using Curtail herbicide at a rate of 2 pints/acre. The field was hand weeded on May 17 and spot sprayed for Canada thistle on June 4. On August 14, the field was sprayed with 2 pints/acre of 2,4-D herbicide. On September 17, urea fertilizer was applied at a rate of 44.5 pounds of actual N/acre. On September 24, Curtail herbicide was applied at a rate of 2 pints/acre for broadleaf weed control.

2010: The field was sprayed with Trust™ herbicide on April 21 at a rate of 4 pints per acre. Curtail herbicide was applied on May 14 at a rate of 3 pints per acre for broadleaf weed control. The field was hand weeded on May 17. A fall pre-emergent herbicide application of Trust was applied in September 21 at 4 pints per acre. Fifty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 4. The field was not irrigated in 2010.

2011: On April 28, the field was fertilized with 40 pounds of actual N in the form of 46-0-0 urea. On May 18, Curtail herbicide was applied at a 2 pint per acre rate. Class Act surfactant was applied at a 2 pint per acre rate. Weeds were removed by hand on June 3. The field was harvested on July 13. The field was rototilled between rows on August 30 and September 15 for weed control. On October 19 the field was fertilized with 40 pounds of actual N. using 46-0-0 granular urea. Trust herbicide was applied for pre-emergent weed control at a rate of 4 pints per acre on November 4. The field was not irrigated in 2011.

2012: The field was tilled between rows on April 26. Prowl Herbicide was applied at a rate of 3 quarts per acre. Weeds were hand rogued on June 6. The field was harvested on June 25. On July 22, the field was tilled between rows for weed control. The field was irrigated with ½ inch of water on August 24. Forty pounds of actual nitrogen was applied using 46-0-0 urea on September 28. A pre-emergent application of Trust herbicide was applied on October 1.

2013: Trust herbicide was applied on October 24, 2012 at a rate of 2 pints per acre. The field was fertilized on October 28, 2012 applying 50 pounds of actual nitrogen per acre using dry urea

Plant performance:

2008: Seedlings were slow to emerge. A fair stand was present by mid-summer. Weeds presented a problem during the summer and herbicide applications were necessary to reduce the weed pressure. Seed continued to germinate and the stand improved by late summer.

2009: A good stand had established by the end of 2009.

2010: The stand is well established.

2011: Excellent stand.

2012: Excellent stand.

2013: Excellent stand.

Harvest and cleaning:

2008: No harvest was done in 2008.

2009: Seed was straight combined on July 2 using a Kincaid model 2065 combine. The combine cylinder speed was set at 1200 rpm, cylinder clearance was 7 millimeters and the fan wind speed set on 4 (mostly closed) with a wind board adjustment of 2 (places air flow on the front of the sieve). The chaffer sieve was ½ inch open and the finishing sieve was set using the medium hole. The combine was operated at 1 mph. The bulk dirty weight of the seed was 123 pounds. The seed was cleaned using a debearder and fanning mill. The seed was debearded for 15 minutes at 235 rpm to break up and remove awns. The seed was then run through a 3-screen model 334 Clipper Fanning Mill using a #9 screen size for the first screen, a #8 screen size for the second screen and a 1/22 screen size for the third screen. The air speed was 225 rpms and the side plate setting was open. The seed was run through the fanning mill twice resulting in 79 bulk clean pounds. The seed was sent in for seed tests and test results showed 99.69% purity, 8% germination and 72% dormant seed. The total clean seed amount was 63.2 pounds PLS.

2010: Seed was straight combined on July 1 using a Massey Ferguson model 17 combine. Combine settings were set the same as in 2009. The bulk dirty weight of the harvested seed was 333 pounds. The seed was cleaned using the same cleaning protocol as in 2009. The clean seed amount was 281 bulk clean pounds. Seed was sent in for tests resulting in 99.96% purity, 4% germination and 90% dormant seed. The total weight of pure live seed was 264 pounds.

2011: Harvested on July 13. Cleaned seed amount was 142.5 pounds PLS.

2012: The field was harvested on June 25. Seed was cleaned and tested and resulted in 39.8 PLS pounds.

2013: The field was harvested on July 11. Seed was cleaned and tested and resulted in 68 PLS pounds.

**Western wheatgrass: accession 9092165**

Seed cleaning of collected seed: Hammermill and a two-screen office fanning mill. The material was first run through a hammermill to break the seed from the stem. The material was hammered milled twice. The first run was with a ¼-inch screen size. The second run was through a 3/16-inch screen. The office mill screen sizes were 1/12 x 1/2 on top and a blank screen on the bottom for the first run. The second run used a 1/14 x 1/4 screen on top and a blank on the bottom. The side plate setting was ¼ open on both runs.

Seeding date: May 6, 2008.

Site preparation: The seedbed was prepared by working twice with a 6-foot S-tine cultivator and packing twice with a Brillion packer.

Seeding: A seeding rate of 35 PLS per linear foot was used for planting the field. Fourteen rows, approximately 1,290 feet long, were planted using a modified Truax grass drill with 42-inch row spacing (1.5 acres). The seed was planted at a depth of 1/2 inch. The field is located in panel G-2 of the PMC.

Maintenance:

2008: On May 27 and again on June 19, the field was sprayed for weeds using Buctril™ herbicide at a rate of 1.5 pints per acre. On June 27, and again on July 11, Sterling™ herbicide at the rate of 1 pint per acre was applied to the field. The field was hand rogued to remove weeds throughout the summer. Irrigation water was applied during the growing season. On September 3, the field was sprayed with 2 pints per acre of 2,4-D herbicide for fall emerging weeds. The field was fertilized on September 22, using 46-0-0 urea at a rate of 90 pounds of actual N per acre. A fall pre-emergent application of Trust™ herbicide was applied on October 9, at a rate of 1.5 pints per acre. The field was lightly tilled the same day using a 2-row tiller to incorporate the Trust™ herbicide.

2009: The field was sprayed on May 7 with Curtail herbicide at a rate of 2 pints/acre. The field was hand weeded on May 11 and 28. The field was walked and spot sprayed for Canada thistle on June 4. On August 14, the field was sprayed with 2 pints/acre of 2,4-D herbicide. On September 17, urea fertilizer was applied at a rate

of 44.5 pounds of actual N/acre. On September 24, Curtail herbicide was applied at a rate of 2 pints/acre for broadleaf weed control.

2010: The field was sprayed with Trust™ herbicide on April 21 at a rate of 4 pints per acre. The field was hand weeded on May 17 and 19. A fall pre-emergent herbicide application of Trust was applied in September 21 at 4 pints per acre. Fifty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 4. The field was not irrigated in 2010.

2011: The field was fertilized on April 29 with 40 pounds actual N. Two pints per acre of Curtail herbicide and 2 pints per acre of Class Act surfactant were applied on May 18. The field was harvested August 9. On October 20, forty pounds of actual N was applied. On November 4, Trust herbicide was applied at 4 pints per acre rate.

2012: On April 26, Prowl herbicide at the rate of 3 quarts per acre were applied. The field was not harvested and residue was mowed on July 27. Fertilizer was applied at 40 pounds actual nitrogen on September 28. Application of Trust herbicide was applied on October 2 at a rate of 4 quarts per acre to control pre-emergent weeds the following spring.

2013: Trust herbicide was applied on October 24, 2012 at a rate of 2 pints per acre. The field was fertilized on October 28, 2012 applying 50 pounds of actual nitrogen per acre using dry urea.

#### Plant performance:

2008: The seedlings emerged very well and a good stand was established by mid-summer.

2009: A very good stand has established. The stand produced a very heavy seed crop that lodged by the end of summer.

2010: The stand is well established.

2011: The field was heavily lodged by harvest and combining could only be done going in a south direction. The field had heavy growth but only fair seed production.

2012: No seed production but good vegetative growth. The field has grown solid and needs to be reestablished in the future.

2013: The field is a solid stand.

#### Harvest and cleaning:

2008: No harvest was done in 2008.

2009: Seed was straight combined with a Massey Ferguson model 17 on August 14. The combine was set with a cylinder speed of 900 rpms. A cylinder clearance of 8 millimeters, a fan wind speed of 1(closed) and a wind board adjustment of 4 (wind placed near the front of sieve). The chaffer sieve adjustment was ½ inch open and a medium hole finishing sieve was used. The combine was operated at 1 1/2 miles per hour. The bulk dirty weight of the seed was 801 pounds. The seed was cleaned through a 3 screen Model 334 Clipper Fanning Mill using a 1/14x1/2 screen size for the first screen, a 1/16 x ¼ screen for the second and a 9 triangle for the third screen. The 9 triangle screen was covered with plastic except for the bottom 1 inch of the screen. The air speed was 258 rpm with the side plate open. The seed was run a second time through the fanning mill using the same settings. The bulk clean seed amount was 393 pounds. The seed was sent in for seed tests and test results showed 94.12% purity, 83% germination, and 0% dormant seed. The total clean seed amount was 307 pounds PLS.

2010: Seed was straight combined on August 5 using a Kincaid Model 2065 combine. Combine settings were cylinder speed 950 rpm, cylinder clearance 8mm, fan wind speed of 1 (closed) and a wind board adjustment of 4 (wind placed near the front of sieve). The chaffer sieve adjustment was ½ inch open and a medium-hole finishing sieve was used. The combine was operated at 1 1/2 miles per hour. The bulk dirty weight of the harvested seed was 678 pounds. The seed was cleaned using a Clipper 29D four-screen fanning mill. The clean seed amount was 233 bulk clean pounds. Seed was sent in for tests resulting in 93.49% purity, 91% germination and 2% dormant seed. Pure live seed totaled 202.6 pounds.

2011: The field was swathed on August 8 due to severe lodging. It was combined with a MF-17 combine on August 9. Combine settings were similar to past years. Seed was cleaned and tested for purity and germination resulting in 98.2 pounds of PLS.

2012: No harvest.

2013: the field was harvested on August 1. Seed was cleaned and tested resulting in 54 PLS pounds of seed.

#### **Slender wheatgrass: accession 9092166**

##### Seed cleaning of collected seed:

Hammermill and two-screen office fanning mill. The seed was initially run through a hammermill to separate seed from the stems. A ¼-inch screen size was used on the hammermill and a slow speed was used. The material was fed at full rate. The material was hammermilled twice. The seed was then run through an office mill twice. The first run used a # 12 screen size for the top screen and a blank screen was used on the bottom. A #10 screen size was

used as the top screen with a blank screen being used on the bottom for the second run. The side plate setting on the office mill was ¼ open for both runs.

Seeding date: May 6, 2008

Site preparation: The seedbed was worked twice with a 6-foot S-tine cultivator and packing twice with a Brillion packer.

Seeding: A seeding rate of 25 PLS per linear foot was used for planting the field. Six rows, approximately 1,039 feet long, were planted using a modified Truax grass drill with 42-inch row spacing (0.95 acre). The seed was planted at a depth of 1/2 inch. The field is located in panel G-2 of the PMC.

Maintenance:

2008: On May 27 and again on June 19, the field was sprayed for weeds using Buctril™ herbicide at a rate of 1.5 pints per acre. On June 27 and again on July 11, Sterling™ herbicide at the rate of 1 pint per acre was applied to the field. The field was hand rogued to remove weeds throughout the summer. Irrigation water was applied during the growing season. The field was fertilized on September 22, using 46-0-0 urea at a rate of 90 pounds of actual N per acre. A fall pre-emergent application of Trust™ herbicide was applied on October 9, at a rate of 1.5 pints per acre. The field was then lightly tilled the same day using a 2-row tiller to incorporate the Trust™ herbicide.

2009: The field was sprayed on May 7 with Curtail herbicide at a rate of 2 pints/acre. The field was hand weeded on May 28. The field was walked and spot sprayed for Canada thistle on June 4. On September 17, urea fertilizer was applied at a rate of 44.5 pounds of actual N/acre. On September 24, Curtail herbicide was applied at a rate of 2 pints/acre for broadleaf weed control.

2010: The field was sprayed with Trust™ herbicide on April 21 at a rate of 4 pints per acre. The field was hand weeded on May 10. A fall pre-emergence herbicide application of Trust was applied in September 21 at 4 pints per acre. Fifty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 4. The field was not irrigated in 2010.

2011: On April 26, Trust herbicide was applied at 2 pints per acre. Fertilizer was applied at a rate of 40 pounds actual nitrogen per acre. Broadleaf weed control applied on May 18 using 2 pints Curtail and 2 pints Class Act surfactant. The field was harvested on July 20. The field was tilled between rows on August 8 and again on October 17. Fertilizer was applied on October 18 using 40 pounds actual urea per acre. On November 4, the pre-emergent herbicide Trust was applied at 4 pints per acre.

2012: The field was discontinued and was sprayed with glyphosate on May 10 using a rate of 2 pints per acre tank mixed with 2 pints Class Act surfactant. The residue was mowed on June 2.

Plant performance:

2008: A stand was well established by the end of the growing season. A fair amount of the plants matured and produced seed.

2009: The stand established very well and produced large amounts of vegetation and a fair seed crop.

2010: The stand is well established.

2011: The field had good growth and continues to produce good seed harvests.

2012: The seed production goals for slender wheatgrass have been met and the field has been removed.

Harvest and cleaning:

2008: Twenty-eight pounds of dirty seed was harvested on September 15. A Wintersteiger plot combine was used for the harvest. The combine settings were as follows: cylinder speed was 850 rpm, cylinder clearance was 1 millimeter for the front and rear. Fan speed was set at 670 rpm. A large-hole chaffer sieve was used and the finishing sieve was set at the sixth hole from the rear of the combine. The seed was cleaned using a 3-screen Clipper 334 Fanning Mill. The seed was run through the fanning mill twice using the same settings. The #1 screen was a 1/14 x ½ inch slotted hole screen. The #2 screen was a ¼ inch x 1/16 inch slotted hole screen. The #3 screen was a 9-triangle with a 1-inch opening. Air speed was set at 248 rpm with the side plate setting open. The seed was finished using a cylinder indent cleaner with a 3-0 screen size and a cylinder speed of 50 rpm. The feeder speed was set at a slow setting (6) and the feeder capacity set at 1 1/2 inch open. Five pounds of clean bulk seed resulted. This seed will be bulked with the 2010 harvest and tested for purity and germination.

2009: The field was straight combined on July 22 using a Massey Ferguson model 17 combine. The cylinder speed was set at 950 rpm with a 8 millimeter cylinder clearance. The fan wind speed was set on the first hole setting (closed) and the fan wind board was set on the 4<sup>th</sup> hole setting (wind directed to the front of the sieve). The chaffer sieve was set at ¾ inch open and medium hole finishing sieve was used. The combine was operated at 1 1/2 miles per hour. The bulk dirty weight of the seed was 510 pounds. The seed was cleaned through a 3-screen Model 334 Clipper Fanning Mill using a number 13 screen for the first screen, a number 11 for the second, and a 9 triangle screen that was covered with plastic sheeting except for the bottom 3 inches which were

left open for the third screen. The air speed was run at 300 rpm with the side plate open. The seed was run a second time through the fanning mill using a number 11 for the first screen a number 10 for the second screen and a 9 triangle with 3-inch opening for the third screen the air speed was increased to 340 rpm. The bulk clean seed amount was 405 pounds. The seed was sent in for seed tests and test results showed 99.28% purity, 90% germination and 0% dormant seed. The total clean seed amount was 362 pounds PLS. The 5 pounds of 2008 harvest was not mixed with the 2009 harvest. It will be mixed with the 2010 harvest and tested.

2010: The field was straight combined on July 16 using a Kincaid 2065 combine. The cylinder speed was set at 950 rpm with an 8 millimeter cylinder clearance. The fan wind speed was set on the first hole setting (closed) and the fan wind board was set on the 4<sup>th</sup> hole setting (wind directed to the front of the sieve). The chaffer sieve was set at ¾ inch open and medium hole finishing sieve was used. The combine was operated at 1 1/2 miles per hour. The bulk dirty weight of the seed was 401 pounds. The seed was cleaned through a 3-screen Model 334 Clipper Fanning Mill using a number 1/14 x 1/2 screen for the first screen, a number 1/14 x 1/4 for the second, and a 9 triangle screen that was covered with plastic sheeting except for the bottom 3 inches which were left open for the third screen. The air speed was run at 258 rpm with the side plate open. The seed was run through a second time using the same settings. The bulk clean seed amount 347 pounds. The seed was sent in for seed tests and test results showed 98.88% purity, 97% germination and 0% dormant seed. The total clean seed amount was 347.2 pounds PLS.

2011: Harvest was done on July 20 by straight combining using similar settings to past years. Seed was cleaned using the same protocol from previous years. Seed was cleaned tested and resulted in 205.6 pounds PLS.

2012: The field was not harvested in 2012. Production goals have been met and the field was removed.

#### **Blue grama: accession 9092168**

Seed cleaning of collected seed: Debearder and two-screen office fanning mill. The seed was processed through a debearder for 10 minutes before being run through a small office mill. The screens used were a number 10 screen for the top screen and a blank screen on the bottom. The seed was then hand screened to remove the larger sticks. A sample was sent to the seed testing lab and is awaiting germination and purity results.

Seeding date: June 10, 2008

Site preparation: The seedbed was prepared by working twice with a 6-foot S-tine cultivator and packing twice with a Brillion packer.

Seeding: A seeding rate of 70 PLS seeds per linear foot was used for planting the field. Due to the limited amount of seed a plot drill was used to plant a 6-foot x 270-foot bed (0.04 acres). The seed was planted at a depth of 1/2 inch. The bed is located in panel G-2 of the PMC.

#### Maintenance:

2008: On June 19, the field was sprayed for weeds using Buctril™ herbicide at a rate of 1.5 pints per acre. On June 27, and again on July 11, Sterling™ herbicide at the rate of 1 pint per acre was applied to the field. The field was hand rogued to remove weeds throughout the summer. Irrigation water was applied during the growing season. No fertilizer was applied to the field in 2008.

2009: The field was sprayed on May 7 using Curtail herbicide at a rate of 2 pints/acre. Urea fertilizer, 46-0-0 was applied on May 7 at a rate of 44.5 pounds of actual N/acre. The field was hand weeded on May 28. On September 17, urea fertilizer, 46-0-0 was applied at a rate of 44.5 pounds of actual N/acre. On September 24, Trust herbicide was applied at a rate of 1.5 pints/acre.

2010: The field was sprayed with 2 pints of 2,4-D herbicide on June 9. The field was hand weeded July 7. Fifty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 4.

2011: On April 13, the field was burned. A herbicide application of 2 pints of Atrazine per acre was applied on April 26. The field was spot sprayed on May 2 using glyphosate to control cool-season grasses. Fertilizer was applied at a rate of 40 pounds per acre actual nitrogen using 46-0-0 urea. On May 18, broadleaf weeds were sprayed using 2 pints per acre of Curtail herbicide and 2 pints per acre Class Act surfactant.

2012: Residue was burned on April 25. On May 1 fertilizer was applied at a rate of 55 pounds of actual N per acre and the field was sprayed with 2 pints of Atrazine per acre. On May 9 the field size was increased from 0.04 acre to 0.3 acre. The field was seeded using a modified Truax drill with Kincaid cones. Seedbed was black and packed. The field could be rowed by early June. Weeds were controlled on June 15 using Sterling Blue herbicide at a rate of 1 pint per acre. The new seeding was mowed for weeds on July 10. The field was fertilized on September 28 with 40 pounds of actual N per acre.

2013: The field was burned on May 4<sup>th</sup> to remove residue. A pre-emergent herbicide was applied on May 6. Forty pounds of actual nitrogen was applied on May 14. Broadleaf weeds were controlled with the application of 2 pints per acre of Curtail herbicide.

#### Plant performance:

2008: Seedling emergence was slow and a fair stand was evident at the end of the growing season.

2009: By the end of the growing season the small field was well established.

2010: The field is established.

2011: Good stand but poor seed production.

2012: There is a good stand on the old field. The newly planted field planted in May is doing well and was harvested for seed.

2013: Excellent establishment and vigor.

#### Harvest and cleaning:

2008: A limited amount of ripe seed was hand stripped from the plants resulting in 2 pounds of dirty seed. The seed has been cleaned and 206 grams of clean seed were obtained. Due to the limited amount of seed, a 2008 seed test will not be done. The 206 grams will be bulked together with the 2009 harvest and tested at that time.

2009: Seed was straight combined with a Wintersteiger plot combine on September 4. The combine was set with a cylinder speed of 700 rpm, cylinder clearance was set with the front adjustment at 1 millimeter and the back adjustment was set at 2 millimeters. The fan wind speed was set at 650 rpm and the fan door was closed. The large hole chaffer sieve was used and the adjustable grain sieve was set ¼ inch open. The bulk dirty weight of the seed was 18 pounds. The seed was cleaned using a hand screen, then debarred, hand screened a second time and then run through an office mill. The seed was run through an indent cleaner for the final cleaning. The bulk clean seed amount was 8.45 pounds. The seed was sent in for seed tests which resulting in a purity of 96.39%, germination of 85% and 8% dormant seed. The total clean seed amount was 7.6 pounds PLS.

2010: Seed was straight combined with a Wintersteiger plot combine on September 8. The combine was set with a cylinder speed of 950 rpm, cylinder clearance was set with the front adjustment at 1 millimeter and the back adjustment was set at 1 millimeters. The fan wind speed was set at 650 rpm and the fan door was closed. The large hole chaffer sieve was used and the adjustable grain sieve was set ¼ inch open. The bulk dirty weight of the seed was 16 pounds. The seed was debarred, and then run through an office mill. The screen size was a number 12 for the first screen and a blank for the second screen. The air speed was very light and the side plate setting was ¼ inch open. The seed was run through the office fanning mill a second time using a number 9 screen on top and a blank for the second screen. All the machine settings were kept the same except the side plate setting was changed to ½ inch open. The bulk clean seed amount was 4.5 pounds. The seed was sent in for seed tests, resulting in a purity of 37.92%, germination of 74% and 1% dormant seed. The total clean seed amount was 1.3 pounds PLS.

2011: Straight combined on August 25 using a MF-17 combine. Combine settings were; cylinder speed 1200 rpm, cylinder clearance 8mm, fan wind speed 1, Fan door adjustment was on 4. The chaffer sieve was 1/3 of an inch open. A medium hole finishing sieve was used. Ground speed was 1½ miles per hour. Seed was cleaned using previous year settings. Seed was sent in for germination and purity tests and resulted in 4.65 pounds PLS.

2012: The field was straight combined using a Wintersteiger combine. A cylinder speed of 1000 rpm with cylinder clearance set at F1 and R1. Fan wind speed was 650 rpm. The fan door was closed. The large hole chaffer sieve was used and the finishing sieve was ½ inch open. Ground speed was 1 mile per hour. A later harvest of the newly planted field was also taken on August 8<sup>th</sup>. The seed was mixed together and cleaned using a 4 screen fanning mill. Screen sizes were a number 12 for the first screen, a number 11 for the second screen, a number 8 with ½ of the screen open for the third screen and a 9 tri with 1 inch open for the fourth screen. Air speed was 157 rpm, the top door was removed, and the shaker speed was set at 400 rpm. Seed was sent in for purity and germination tests and resulted in 19.59 pounds.

2013: The field was combined with a Wintersteiger plot combine on August 20. Seed was cleaned and tested resulting in 98 PLS pounds of seed.

#### **Sand dropseed: accession 9092169**

Seed cleaning of collected seed: The park seed was separated from the stems by hand stripping. The seed was then hand screened using a pan screen to separate sticks and chaff out.

Seeding date: Approximately 700 greenhouse grown plants were transplanted to the field on May 22, 2008.

Site preparation: The bed was prepared by working twice with a 6-foot S-tine cultivator and packing twice with a Brillion packer. A specialized tool bar with two chisel shovels spaced 42 inches apart was used to make 2 rows for transplanting.

Seeding: Due to the limited amount of seed available, plants were grown in the greenhouse and then planted into the field. Seed was planted in flats in the greenhouse on February 14. Plantlets were transplanted from the flats into containers when they were approximately ½ inch tall. The plants were allowed to grow in the greenhouse until

May 12, when they were moved to the lathhouse to harden off for transplanting into the field. Approximately 700 plants were transplanted into two 283 foot long rows in panel G-2 of the PMC.

#### Maintenance:

2008: The plants were irrigated on May 23, the day after planting, to optimize transplant survival. On May 27 and again on June 19, the field was sprayed for weeds using Buctril™ herbicide at a rate of 1.5 pints per acre. On June 27, and again on July 11, Sterling™ herbicide at the rate of 1 pint per acre was applied to the field. The field was hand rogued to remove weeds throughout the summer. Irrigation water was applied during the growing season. No fertilizer was applied to the field in 2008.

2009: The field was sprayed on May 7 using Curtail herbicide at a rate of 2 pints/acre. Urea fertilizer, 46-0-0 was applied on May 7 at a rate of 44.5 pounds of actual N/acre. The field was hand weeded on May 28. On September 17, urea fertilizer, 46-0-0 was applied at a rate of 44.5 pounds of actual N/acre. On September 24, Trust herbicide was applied at a rate of 1.5 pints/acre.

2010: The field was sprayed June 9 with 2,4-D at a rate of 2 pints per acre for broadleaf weed control. The field was hand weeded on July 7. Fifty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 4. The field was not irrigated in 2010.

2011: The two rows were burned on April 13. The field was fertilized on May 2 with 40 pounds of actual N per acre. Weeds were spot sprayed on May 2. On May 18, two pints of Curtail herbicide tank mixed with 2 pints of Class Act were applied for broadleaf weed control. The field was harvested on August 8. On August 30 the rows were tilled between. Fertilizer was applied at a rate of 40 pounds per acre actual nitrogen. On November 4, four pints per acre of Trust herbicide were applied to the field.

2012: On May 1 the field was fertilized with 25 pounds of actual N. Two pints per acre of Atrazine herbicide was applied on May 1. The field size was increased on May 10 from 0.03 acre to 0.1 acre. Seed was broadcast on a clean soil surface. On June 13, Sterling Blue herbicide was applied at a rate of 1 pint per acre for broadleaf weed control. On July 10, weeds were mowed on the new field. The old field was harvested on July 16.

2013: The field was fertilized on May 14 with 40 pounds of actual nitrogen urea. Broadleaf weeds were controlled with 2 pints per acre of Curtail herbicide.

#### Plant performance:

2008: Survival was excellent and most of the plants produced viable seed the first year.

2009: The small field established well and a good seed crop was harvested.

2010: The field is well established.

2011: Good growth and seed production.

2012: Seed production was fair on the old stand. The new seeding was slow to germinate due to dry conditions. By the end of the summer a fair stand had established and a small amount of seed was harvested by the end of the summer

2013: A fair stand has established.

#### Harvest and cleaning:

2008: A small harvest of 5 pounds dirty seed was taken using a Wintersteiger plot combine. The combine was set with a cylinder speed of 700 rpm, cylinder clearance of 1 millimeter in front and 1 millimeter in the rear. The fan speed was set at 600 rpm with the fan door closed. The large hole chaffer sieve was used and the adjustable grain sieve was ½ inch open. The 5 pounds of 2008 harvested seed was cleaned using a hammermill to breakup stems and remove seed from the seed heads. The hammermill was run at a slow speed with a full rate of feed. The screen size was a 1/8 inch hole. The seed was then run across an office mill twice using the same settings, a 1/12 inch screen size for the first screen and a blank for the number 2 screen. The air speed was slow, side plate setting was closed. The seed was finished using an indent cleaner with a 2.75 inch screen. Three pounds of clean seed resulted. The 3 pounds of clean seed was not sent in for testing and will be bulked with the 2009 harvest and tested.

2009: Seed was straight combined with a Wintersteiger plot combine on July 31 when a majority of the seed was mature. The combine was set with a cylinder speed of 700 rpm, cylinder clearance 1 millimeter in the front and 2 millimeters in the back, fan wind speed of 650 rpm and the fan door was closed. A large hole chaffer sieve was used. The adjustable grain sieve was set at ½ inch open. The bulk dirty weight of the seed was 6 pounds. The seed was cleaned using a small office mill with the first screen a 1/13 and the second screen a blank. The seed was run a second time changing the number one screen to a 1/15 screen and all other adjustments were left the same. The bulk clean seed amount was 5.5 pounds. The 5.5 pounds of 2009 seed was bulked with the 3 pounds of 2008 harvest and sent in for seed tests. Tests are pending at this time.

2010: Seed was straight combined with a Wintersteiger plot combine on August 28 some seed had already shattered from the plants. The combine was set with a cylinder speed of 750 rpm, cylinder clearance 1

millimeter in the front and 1 millimeter in the back, fan wind speed of 650 rpm and the fan door was closed. A large hole chaffer sieve was used. The adjustable grain sieve was set at 3/8 inch open. The bulk dirty weight of the seed was 10 pounds. The seed was cleaned using a hand screen with 8/64 round hole screen size. A small office mill was used next with the first screen a 1/16 and the second screen a blank. The bulk clean seed amount was 7 pounds. The seed was sent in for seed tests which resulting in a purity of 96.47%, germination of 32% and 56% dormant seed. The total clean seed amount was 5.9 pounds PLS.

2011: The field was straight combined using a Wintersteiger plot combine on August 8. The combine was set with a cylinder speed of 600 rpm. Cylinder clearance was set on F1 and R1. The fan wind speed was 650 rpm and the fan door was 1 inch open. A large hole chaffer sieve was used and the finishing sieve was 1/3 inch open. The seed was cleaned using an office fanning mill and indent cleaner. The clean seed amount was 2.9 pounds PLS.

2012: The field was straight combined using a Wintersteiger plot combine. The cylinder speed was 960 rpm and cylinder clearance was set at F1 and R1. The fan wind speed was 650 rpm. A medium holed chaffer sieve was used. The finishing sieve was set 3/8 inch open. The seed was cleaned using a small office mill and indent cleaner. Clean seed was 14.9 pounds PLS.

2013: A Wintersteiger plot combine was used to harvest the field on July 30. Seed was cleaned and tested resulting in 10 PLS pounds.

**Figure BA-1. Field map, G-2.**

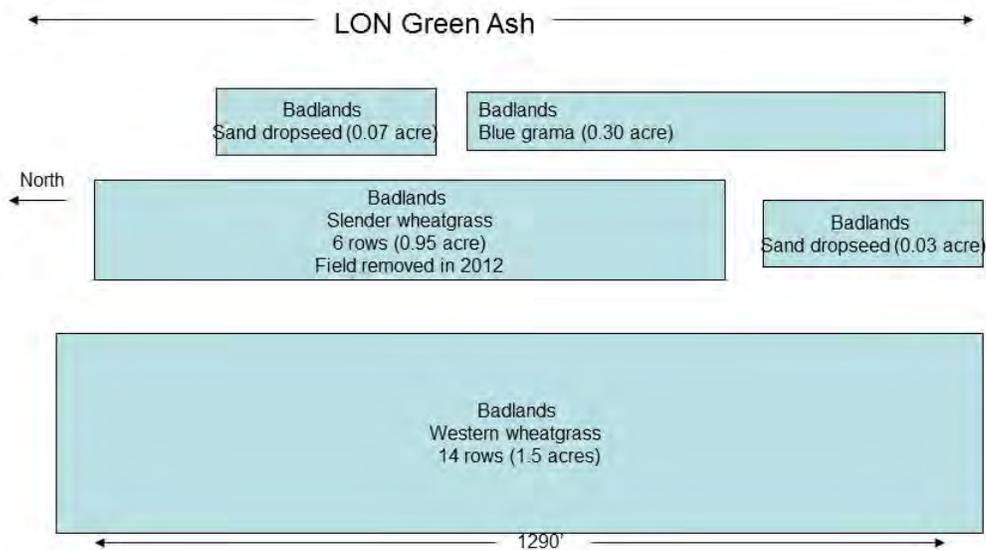
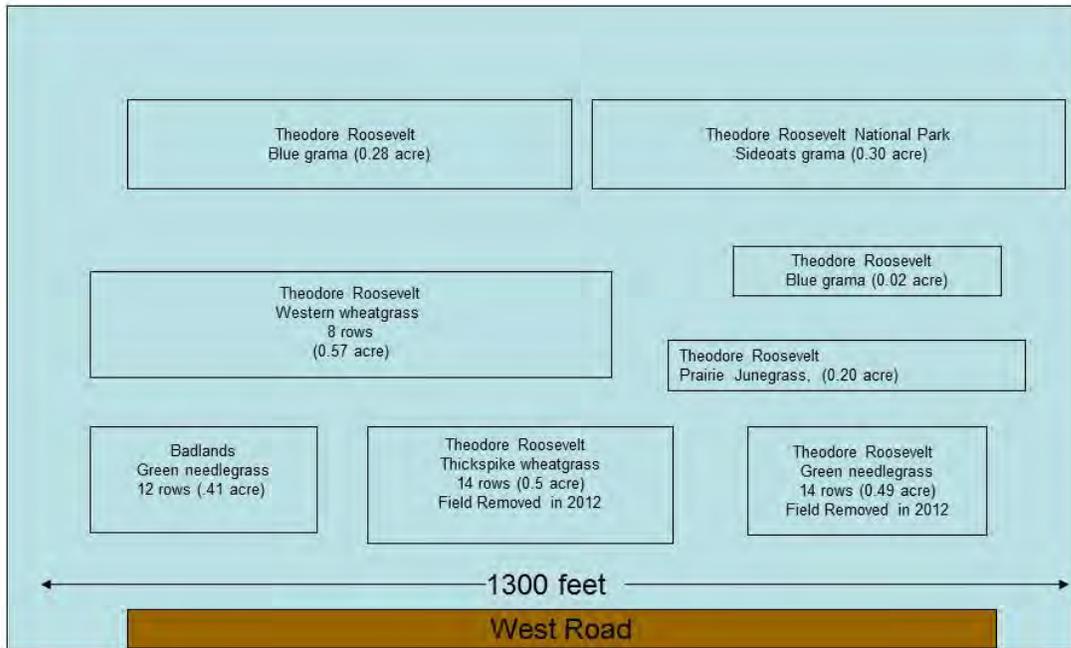


Figure BA-2. Field map, G-4.



## ACTIVE STUDIES - TECHNICAL REPORT 2013

Study No. NDPMC-S-1004-CR

Study Name: Grand Teton National Park

Introduction: The Natural Resources Conservation Service (NRCS), Plant Materials Center (PMC), Bismarck, North Dakota, entered into an interagency agreement on June 1, 2010, with the National Park Service (NPS), Grand Teton National Park (GTNP) to grow and produce seed of bluebunch wheatgrass (*Pseudoroegneria spicata*), slender wheatgrass (*Elymus trachycaulus*) and mountain brome (*Bromus marginatus*) for use in revegetating Kelly Hay Fields. Fields were established at the PMC in 2010 with seed originating from GTNP. Seed was harvested from these fields in 2011, 2012 and 2013 and will be distributed to GTNP for reclamation activities.

### **Targeted Species and Goaled Seed Amounts**

Species	Common Name	PLS Pounds
<i>Pseudoroegneria spicata</i>	bluebunch wheatgrass	100
<i>Elymus trachycaulus</i>	slender wheatgrass	720
<i>Bromus marginatus</i>	mountain brome	520

Accomplishments: Seed from GTNP was given to the Bismarck PMC to establish seed production fields at the PMC. The PMC assigned each species an accession number and recorded it in a seed inventory database. See Table GT-1 for cumulative information on targeted species collected at Grand Teton National Park.

Accession Number	Species	Seeding Date	Seeding Rate (PLS lb/ac)	Field Size (ac)
9094354	mountain brome	5/26/2010	10.0	1.0
9094353	slender wheatgrass	5/26/2010	5.5	1.0
9094352	bluebunch wheatgrass	6/2/2010	9.5	0.5

Site preparation: All three fields were prepared using an S-tine field cultivator and packed with a Brillion packer prior to seeding. The prior crop was an oats cover crop that was chemically killed with glyphosate herbicide the summer of 2009. No pre-plant herbicides were used. Field conditions were good with a firm seedbed. Soil moisture was good.

Seeding: A modified Truax grass drill was used for the planting. The seed was planted in 42 inch rows. Seed was planted approximately ½ inch deep.

### **Mountain brome: accession 9094354**

A 1-acre field of mountain brome was planted in field E-10 at the PMC on May 26, 2010. The field was seeded at a rate of 10 lbs pure live seed (PLS)/ac, resulting in 25 PLS/foot of row to be planted.

#### Field Maintenance:

2010: The field was irrigated for 3 hours on June 9. The field was sprayed for weeds using Buctril™ herbicide at a rate of 1.5 pints per acre on June 17. The field was mowed for weed control on July 22 with a rotary mower. A fall pre-emergent application of Trust™ herbicide was applied on September 21 at a rate of 4 pints per acre. No fertilizer was applied during the establishment year.

2011: Residue was burned April 13. Forty pounds of actual nitrogen fertilizer was applied on April 28. Curtail Herbicide was applied on May 18 at a rate of 2 pints per acre. Class Act surfactant was tank mixed with the herbicide. The field was tilled between rows on September 6. The field was fall fertilized with 40 pounds of actual nitrogen as granular 46-0-0. The field was sprayed with Trust herbicide for pre-emergent control of spring weeds on November 4.

2012: The field was rototilled between rows on April 26. Prowl herbicide was applied pre-emergent at a rate of 2 quarts per acre on April 26. Tillage between rows was done after harvest on July 17. The field was irrigated on August 30 applying approximately 1 inch of water. . Forty pounds per acre of actual nitrogen was applied as dry urea 46-0-0 on September 17. The field was irrigated with ½ inch of water on September 20 to help incorporate the fertilizer. On October 2 the field was sprayed with Trust herbicide at a rate of 4 quarts per acre for pre-emergent spring weed control.

2013: The field was tilled between rows on May 23. Urea 46-0-0 fertilizer was applied at the rate of 50 pounds of actual N per acre on October 24. Trust herbicide at the rate of 2 pints per acre was applied on October 24.

#### Harvest and Cleaning:

2010: The mountain bromegrass field established quickly and resulted in excellent stand by the end of the growing season. The field was not harvested in 2010.

2011: Smut infected the entire field. The field was straight combined on July 26 producing 19.22 PLS pounds of seed. The seed was cleaned using a 3-screen fanning mill using a no. 12 screen for the first screen a 1/16 x 1/2 inch screen for the second screen and a 9 tri screen with 1 inch opening for the third screen. The air speed was set at 243 rpm with the side plate open.

2012: The field had very little smut infection compared to 2011. This was attributed to the drier less humid growing conditions. The field had good seed production and was straight combined on July 2 using a Kincaid model 17 combine. Dirty seed harvest was 1,056 dirty pounds. The seed was cleaned using a Clipper 3 screen fanning mill with settings the same as in 2011. Clean seed was 908 pounds resulting in 792 pounds of PLS after testing.

2013: The field was harvested straight on July 9 using a MF 17 combine. Very little smut was observed in the field. The seed was cleaned and tested resulting in 407 PLS pounds.

#### **Slender wheatgrass: accession 9094353**

A one-acre field of slender wheatgrass was seeded in field E-11 on May 26, 2010. The seeding rate was 5.5 lb PLS/ac for 20 PLS seeds per foot of row.

#### Field Maintenance:

2010: The field was irrigated for 3 hours on June 9. The field was sprayed for weeds using Buctril™ herbicide at a rate of 1.5 pints per acre on June 24. A second application of Buctril™ herbicide was applied on July 16<sup>th</sup> using a rate of 1.5 pints per acre. The field was mowed for weed control on July 21 with a rotary mower. A fall pre-emergent application of Trust™ herbicide was applied on September 21 at a rate of 4 pints per acre. No fertilizer was applied during the establishment year.

2011: The field was burned on April 13 to remove excessive residue. Fertilizer was applied on April 28 at a rate of 40 pounds of actual nitrogen. On May 19 Curtail herbicide was applied for broadleaf weed control at a rate of 2 pints per acre. Class Act surfactant was tank mixed with the herbicide. The field was rototilled between rows on September 7 after seed harvest. Forty pounds of actual nitrogen in the form of urea-46-0-0 was applied on October 18. The pre-emergent herbicide Trust was applied on November 4<sup>th</sup> at a rate of 4 pints per acre.

2012: The field was rototilled between rows on April 26. Prowl herbicide was applied at a rate of 2 quarts per acre on April 26. The field was mowed and tilled after seed harvest on July 24 and 25. On August 15 1/2 inch of irrigation water was applied to the field. September 17 the field was fertilized using 40 pounds actual N of 46-0-0 fertilizer. The fertilizer was incorporated with irrigation water the following day at a rate of 1/2 inch. Four pints per acre of Trust herbicide were applied to the field on October 1.

2013: The field was tilled between rows on May 23. Urea 46-0-0 fertilizer was applied at the rate of 50 pounds of actual N per acre on October 24. Trust herbicide at the rate of 2 pints per acre was applied on October 24.

#### Harvest and Cleaning:

2010: The slender wheatgrass field established quickly and a good stand was established by the end of the growing season. The field was not harvested in 2010.

2011: Seed was straight combined using a Massey Ferguson model 17 (MF-17) combine on July 20. Combine settings were set for a cylinder speed of 1000 rpm, cylinder clearance 7mm, fan wind speed 2 rpm and the fan door adjustment was set on 4. The chaffer sieve adjustment was 1/2 inch open and a medium hole finishing sieve was used. The ground speed was 2 mph. Seed was cleaned using a 3 screen fanning mill. The first screen was a number 11, second was 1/12x1/2 inch and the third screen was a 9 tri with 1 inch open. The air speed was 234 rpm and the side plate was open. The seed amount was 570 lbs PLS.

2012: The field was straight combined on July 3 using a MF-17 combine. The seed was cleaned using the same settings and screens as 2011. Clean seed weight was 825 lbs PLS.

The field was harvested straight on July 12 using a MF 17 combine. Seed was cleaned and tested resulting in 407 PLS pounds.

2013: The field was harvested straight on July 12 using a MF 17 combine. The seed was cleaned and tested resulting in 505 PLS pounds.

**Bluebunch wheatgrass: accession 9094352**

A 0.5-acre field of bluebunch wheatgrass was seeded in field E-10 on June 6, 2010. The seeding rate was 9.5 lb PLS/ac for 30 PLS seeds per foot of row.

Field Maintenance:

2010: The field was irrigated for 3 hours on June 9. The field was mowed for weed control on July 21 with a rotary mower. A fall pre-emergent application of Trust™ herbicide was applied on September 21 at a rate of 4 pints per acre. No fertilizer was applied during the establishment year.

2011: April 29 the field was fertilized with 40 pounds of actual urea nitrogen. Rows were tilled on May 9. The field was hand weeded on June 7 and 8. On June 27 the field was sprayed with a fungicide for smut control. This was not effective. On October 18 fertilizer was applied at a rate of 40 pounds per acre of actual nitrogen. The field was sprayed with Trust herbicide at a rate of 4 pints per acre.

2012: The stand is poor with numerous bare areas within the rows. Prowl herbicide was applied on April 26 using a rate of 2 quarts per acre. The field became weedy and was mowed on July 17 and again on August 6. Trust Herbicide was applied at a rate of 4 quarts per acre on October 2. The field has a poor stand and will be terminated in 2013.

2013: The field was terminated in 2013.

Harvest and Cleaning:

2010: The bluebunch wheatgrass field was slow to establish. Seedling vigor was noticeably poor for the bluebunch wheatgrass, resulting in a fair stand by the end of the growing season. The field was not harvested in 2010.

2011: The field was harvested on July 22 a poor harvest resulted in less than ½ pound PLS.

2012: The field was not harvested.

2013: The field was removed in 2013.

No seed was distributed to the park in 2011, 2012, or 2013.

**Table GT-1. Seed Production and Distribution**

Accession Number	Species	Date Planted	Field Size (ac)	2013 Seed Production (PLS lb)	2013 Seed Harvest Date	Seed Distribution to Park in 2013 (PLS lb)	Inventory Remaining (PLS lb)
9094352	Bluebunch wheatgrass	6/2/2010	0.5	-----field removed-----		0	0.27
9094353	Slender wheatgrass	5/26/2010	1	505	7/12/2013	0	1,939
9094354	Mountain brome	5/26/2010	1	407	7/9/2013	0	1,219

**ACTIVE STUDIES - TECHNICAL REPORT 2013**

Study No. NDPMC-S-1304-CR

Study Name: Mount Rushmore National Memorial

Introduction: The Natural Resources Conservation Service (NRCS), Plant Materials Center (PMC), Bismarck, North Dakota, entered into an interagency agreement on August 30, 2013, with the U.S. Department of Interior (USDI) National Park Service (NPS), Mount Rushmore National Monument to increase seed of big bluestem (*Andropogon gerardii*) and little bluestem (*Schizachyrium scoparium*) for use in rehabilitation of social trails at Mount Rushmore Memorial.

**Targeted Species and Goaled Seed Amounts**

Species	Common Name	PLS Pounds
<i>Andropogon gerardii</i>	big bluestem	80
<i>Schizachyrium scoparium</i>	little bluestem	80

Accomplishments: Seed was collected the fall of 2013 by NPS employees. The seed was picked up by the NRCS Plant Materials Center staff on March 19, 2014, and brought to the PMC. The seed was weighed resulting in 6.5 pounds dirty weight of little bluestem and 13.5 pounds dirty weight of big bluestem. The seed will be cleaned at the PMC and tested at the North Dakota State Seed Lab. A 0.8-acre seed increase field will be seeded in the spring of 2014 in panel A-4 at the NRCS Bismarck Plant Materials Center. The fields will be maintained in 2014 while they establish. The first seed harvest from these fields is planned for 2015.

## **ACTIVE STUDIES: TECHNICAL REPORT 2013**

### Study NDPMC-T-0105-CP

Study Title: Plant Materials for Saline Sites

Introduction: Salinity is a soil property referring to the amount of soluble salt in the soil. It is generally a problem of arid and semiarid regions. Electrical conductivity (EC) is the most common measure of soil salinity and is indicative of the ability of an aqueous solution to carry an electric current. By agricultural standards, soils with an EC greater than 4 dS/m are considered saline. In actuality, salt-sensitive plants may be affected by conductivities less than 4 dS/m and salt tolerant species may not be impacted by concentrations of up to twice this maximum agricultural tolerance limit.

Objective: Compare establishment and forage production of perennial grasses and legumes over salinity gradients.

Cooperators: Carrington Research Extension Center, Carrington, North Dakota The USDA Natural Resources Conservation Service Plant Materials Center, Bismarck North Dakota, Foster and Stutsman County Soil Conservation Districts

Location: Three sites located near Barlow, Buchanan, and Carrington, North Dakota

Major Land Resource Area: The study is located in MLRA 53B.

#### Soils:

Barlow: G211A, Fram-Wyard loams, 0 to 3 percent slopes  
G229A, Heimdal-Emrick loams, 0 to 3 percent slopes

Buchanan: 18, Hamerly-Svea loams, 0 to 3 percent slopes  
24, Svea-Barnes loams, 0 to 3 percent slopes

Carrington: G119A, Vallers-Hamerly loams, saline, 0 to 3 percent slopes  
G230B, Heimdal-Esmond loams, 3 to 6 percent slopes

### **Materials and Methods**

Planting Plan: Three off-center demonstration plots were seeded the spring of 2010. Two of the plots are located in close proximity of the Carrington Research and Extension Center in central North Dakota. See **Figure CA-1** for plot layout at the pasta plant location. The third is located east of Buchanan, North Dakota. The plots will not be replicated but each species will be planted through a recorded salinity gradient. Data collection will be as follows:

1. Plant germination and stand establishment counts were taken across the gradient for each species.
2. Stand health and progression or regression across the gradient will be measured annually.
3. EC will be measured at intervals across the gradient with an EM 38 machine at planting and annually to map changes in salinity throughout the plots over time.
4. Plant herbage production will be taken across the gradient for each species to determine potential yield of each species at differing salinities on dates deemed most appropriate for optimum forage harvest. Grasses will be clipped once per season. Alfalfa and legume species will be clipped twice per year if regrowth is sufficient after the first cutting.
5. Forage quality will be analyzed on all grass species in the trial.

#### Species List:

Smooth Bromegrass - Rebound  
Tall Wheatgrass – Alkar  
Hybrid Wheatgrass - NewHy  
Manystem Wildrye – Shoshone  
Creeping Foxtail – Garrison  
Green Wheatgrass - AC Saltlander

Slender Wheatgrass – Revenue  
 Western Wheatgrass - Rodan  
 Canada Wildrye - Mandan  
 Switchgrass – Forestburg  
 Prairie Cordgrass - Red River  
 Prairie Cordgrass - CREC Germplasm  
 AC Saltlander Commercial Mix of:  
 -50% AC Saltlander Green Wheatgrass  
 -25% Revenue Slender Wheatgrass  
 -25% Courtenay Tall Forage Fescue  
 Alfalfa – 12 varieties/lines  
 Strawberry Clover - O'Connors  
 Forage Kochia - 2 sources

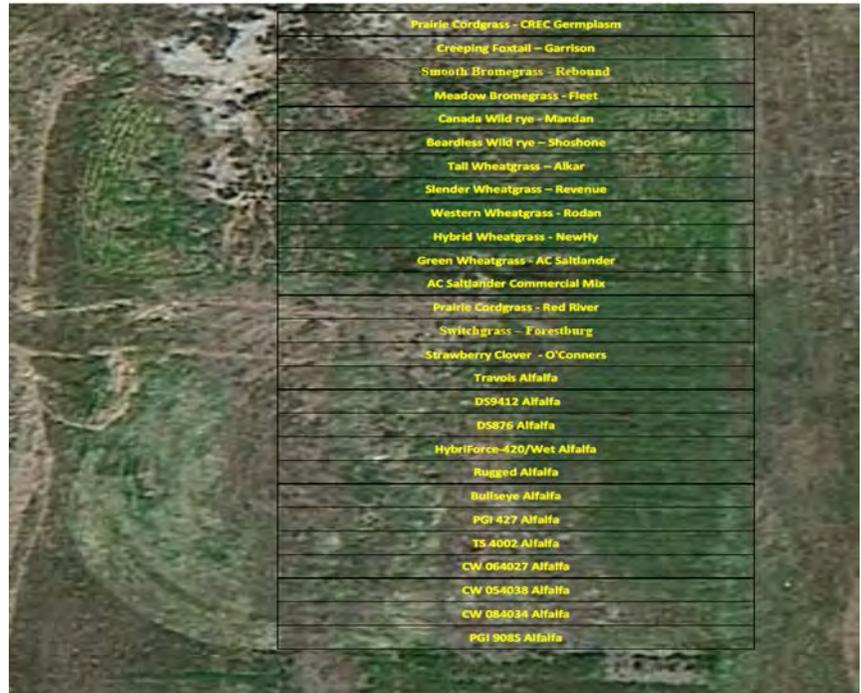
Site Preparation: The sites were tilled prior to seeding

Planting Method: Each plot is 10 feet wide by 200 feet long. A plot drill was used to seed all the plots.

Planting Date: Carrington and Barlow, May 22, 2010 and Buchanan, June 10, 2010

Irrigation: The fields are not irrigated.

**Figure CA-1. Plot layout of salinity demonstration at the Pasta Plant location near Carrington, North Dakota**



## Results and Discussion

A considerable amount of information contained in this report has been provided by Ezra Aberle, Agronomy Research Specialist with the Carrington Research Extension Center.

2010: Plant germination and stand establishment counts were taken across the gradient for each species. Seedlings emerged in most of the test areas, however, many succumbed to the harsh environment in the more saline areas. This season the wheatgrasses provided thicker and more consistent stands across the gradient from non-saline to saline soil than the other grasses tested. This may change over time. There appears to be no clear differences in establishment of the alfalfas tested. This demonstration will track salinity, stand, and forage production over several seasons to help determine the most appropriate species for various salinity levels and targeted end uses by personnel, landowners, and/or renters. See **Table CA-1** for 2010 stand evaluation data.

2011: Plots received above normal precipitation this year, with some areas subjected to short term flooding. Plots of each species that had adequate stands were harvested on July 7<sup>th</sup>, the approximate stage for hay production. The prairie cordgrass plots were not harvested due to minimal, inconsistent, stands throughout the gradients. However, they may be harvested in the future if the stand improves. Harvested forage was weighed to determine yield and sampled for forage quality analysis. EC readings were taken in plots the same day they were harvested for yield. The Barlow site was clipped this year, but abandoned in the fall due to excessively saturated soils which resulted in loss of stand. Forage production and stand counts across increasing salinity levels at the Pasta Plant and Buchanan locations are combined in **Table CA-2** averages. Tall wheatgrass, Canada wildrye, Shoshone many-stem wildrye, most wheatgrasses, and salt tolerant crosses and mixes performed well, even in EC readings as high as 8 dS/m. Tall wheatgrass, Shoshone many-stem wildrye, NewHy and the forage mix appeared to tolerate the highest saline conditions. Alfalfa production dropped off considerably in most entries, as EC ratings approached 5 dS/m. **Table CA-3** indicates the average of the combined forage quality of the grass species at the Pasta Plant and Buchanan locations across different salinity gradients. The forage mix, wheatgrass crosses and western wheatgrass displayed the highest combination of protein and relative feed value of the grasses, and tall wheatgrass was consistently on the lower end of the quality scale.

2012: Plots received considerably less precipitation this growing season and salinity level readings are generally lower as well. The wheatgrasses and Shoshone wildrye continue to provide stable yields across the salinity gradient. The wheatgrasses (with the exception of tall), the bromegrasses, and the wildryes provided forage with quality to maintain a dry or early gestation beef cow. The drop in salinity levels this year may have been a result of drier conditions. **Table CA-4** includes the combined average production of the cool season grasses at the Pasta Plant and Buchanan locations at different salinity gradients. **Table CA-5** includes the combined averages of the forage quality data from the Pasta Plant and Buchanan sites at different salinity gradients.

2013: Plots received good moisture in the early part of the growing season followed by an abnormally dry period in the July-August period. The Pasta Plant and Buchanan cool season grass plots were clipped on July 17. Due to schedule conflicts, this was at least one week later than what would normally be the approximate stage for hay production for most of these species. Results were fairly consistent with previous years as to differences in quality and production for different species and salinity gradients. Combined average production from both the Buchanan and Pasta Plant locations is shown in **Table CA-6**. **Table CA-7** is a 3 year summary of combined average production from both locations and all salinity gradients from 2011-2013. The numbers in bold indicate which species had greater production than the average of all species at each salinity gradient. Tall wheatgrass, NewHy, AC Saltlander, and the forage mix again provided the highest amounts of biomass. **Table CA-8** includes the combined averages of the forage quality data from the Pasta Plant and Buchanan sites at different salinity gradients. **Table CA-9** is a summary of forage quality averages from the previous table. Shoshone wildrye had the highest crude protein, but fell below the average in overall feed value, along with the tall and the slender wheatgrass varieties. The remaining species had RFV greater than the average of all. Comparing both production and forage quality together, it appears that AC Saltlander, NewHY, and AC Saltlander commercial mix perform best in the observed salinity gradients. **Figure CA-2** indicates saline tolerance of each grass species and provides confirmation that the varieties developed for saline tolerance perform well under typical field conditions, both in productivity and forage quality.

Listed below are definitions of abbreviations used in the following tables:

<b>Abbreviations Key</b>	
<b>AP</b> = Available Protein,%	<b>NDF</b> = Neutral Detergent Fiber,%
<b>ADF</b> = Acid detergent Fiber,%	<b>NFC</b> = Non-Fiber Carbohydrates.,%
<b>Ca</b> = Calcium (Ca),%	<b>NEL</b> = Net Energy for maintenance, MCAL/LB
<b>CF</b> = Crude Fiber,%	<b>NEM</b> = Net Energy for Lactation ,MCAL/LB
<b>CP</b> = Crude Protein,%	<b>NEG</b> = Net Energy for Gain, MCAL/LB
<b>DDM</b> = Ddigestible Dry matter,%	<b>P</b> = Phosphous (P),%
<b>HDP</b> = Heat Damaged Protein,%	<b>RFV</b> = Relative feed Value
<b>K</b> = Potassium (K),%	<b>TDN</b> = Total Digestible Nutrients EST.,%
<b>Mg</b> = Magnesium (Mg),%	

**Table CA-1. 2010 stand counts (plants/ft<sup>2</sup>) for all locations**

2010 Carrington Salinity Trial Initial Stand Counts from 3 locations (plants/ ft <sup>2</sup> at various salinity levels)														
Location	prairie cordgrass		slender wheatgrass		creeping foxtail		smooth brome		meadow brome		Canada wildrye		manystem wildrye	
	plants/ft <sup>2</sup>	EC Reading												
<b>Pasta Plant</b>	0	1.12	12	0.74	30	1.13	23	0.93	36	1.11	7	1.03	17	1.09
	0	1.36	14	1.12	43	1.15	37	0.96	30	1.29	11	1.43	8	1.13
	1	2.24	26	1.26	1	1.38	6	1.19	18	1.40	12	1.49	17	1.25
	0	2.40	23	1.32	13	1.40	44	1.36	26	1.52	25	1.52	38	1.32
	0	2.54	29	1.35	14	1.67	25	1.58	15	1.66	22	1.53	14	1.46
	0	2.55	16	1.58	12	1.99	17	1.68	44	1.81	15	1.63	24	1.78
	1	2.55	48	1.70	4	2.27	8	2.34	24	1.90	0	1.74	15	1.89
	1	3.42	6	2.30	3	2.33	0	2.48	0	1.95	6	1.86	5	2.19
	1	3.46	11	2.53	0	2.50	15	2.58	10	2.34	4	2.39	3	2.40
	0	3.46	4	3.05	3	2.60	1	2.60	2	2.47	2	2.49	2	2.48
	0	3.48	18	3.85	23	2.73	17	2.98	28	3.12	11	2.60	3	2.49
	0	4.14	4	3.89	6	3.24	12	3.21	0	3.49	15	3.06	43	2.65
	0	4.62	6	4.37	9	4.96	5	3.22	12	3.67	1	3.33	7	3.61
	0	4.98	19	5.18	0	4.96	1	3.55	8	4.11	0	3.33	23	7.43
0	4.98	0	5.18	0	5.57	3	3.55	5	4.11	4	4.14	0	7.43	
<b>Barlow</b>			12	0.74	30	1.13	23	0.93	36	1.11	7	1.03	8	1.13
			14	1.12	1	1.38	37	0.96	15	1.66	12	1.49	17	1.25
			26	1.26	13	1.40	6	1.19	44	1.81	25	1.52	24	1.78
			6	2.30	0	2.50	0	2.48	0	1.95	0	1.74	15	1.89
			4	3.05	6	3.24	15	2.58	12	3.67	4	2.39	3	2.40
<b>Buchanan</b>	0	1.36	23	1.32	43	1.15	44	1.36	30	1.29	11	1.43	17	1.09
	1	2.24	16	1.58	14	1.67	25	1.58	18	1.40	22	1.53	38	1.32
	0	2.40	48	1.70	12	1.99	17	1.68	26	1.52	15	1.63	14	1.46
	0	2.54	11	2.53	3	2.33	8	2.34	10	2.34	6	1.86	5	2.19
	0	3.48	4	3.89	3	2.60	1	2.60	2	2.47	2	2.49	2	2.48

Location	prairie cordgrass		slender wheatgrass		creeping Foxtail		smooth brome grass		meadow brome grass		Canada wildrye		manystem wildrye	
	plants/ft <sup>2</sup>	EC Reading												
Pasta Plant	16	0.71	56	0.64	2	0.68	6	0.56	9	0.82	23	1.01	16	0.71
	24	0.79	16	0.83	31	0.88	52	0.56	29	0.86	20	1.05	26	0.99
	4	0.91	29	1.21	32	0.96	16	0.81	13	0.86	16	1.23	28	1.42
	13	1.19	18	1.27	12	1.03	56	0.82	27	1.15	4	1.27	5	1.44
	11	1.22	27	1.30	29	1.16	42	1.62	68	1.15	21	1.74	23	1.50
	28	1.42	33	1.47	27	1.23	12	1.71	20	1.83	43	1.82	33	1.62
	15	1.45	2	1.65	34	1.38	50	1.74	10	2.19	1	1.83	23	1.75
	3	1.90	22	1.75	18	1.53	30	2.70	6	2.43	25	2.46	2	1.80
	10	2.32	6	2.50	11	2.70	30	2.80	14	2.57	4	2.46	26	2.47
	31	2.47	9	3.13	7	2.83	16	2.95	1	2.65	14	2.53	16	2.97
	15	2.80	13	3.36	2	3.31	32	3.42	1	2.69	2	2.77	18	3.41
	6	2.80	0	3.61	11	3.61	26	3.82	1	3.07	8	3.01	27	3.44
	9	3.56	3	4.27	11	4.52	12	3.92	17	3.22	4	3.04	20	5.98
	2	4.13	28	4.29	0	4.52	7	3.92	1	3.22	34	3.38	15	5.98
3	4.60	4	4.29	4	5.45	4	3.98	0	4.30	18	4.37	4	1.88	
Barlow	16	0.71	16	0.83	2	0.68	6	0.56	9	0.82	20	1.05	16	0.71
	4	0.91	18	1.27	31	0.88	52	0.56	29	0.86	16	1.23	5	1.44
	13	1.19	27	1.30	12	1.03	16	0.81	13	0.86	4	1.27	33	1.62
	3	1.90	2	1.65	29	1.16	12	1.71	10	2.19	1	1.83	2	1.80
	10	2.32	6	2.50	7	2.83	32	3.42	1	2.69	2	2.77	4	1.88
Buchanan	24	0.79	56	0.64	32	0.96	56	0.82	27	1.15	23	1.01	26	0.99
	28	1.42	33	1.47	27	1.23	50	1.74	20	1.83	21	1.74	28	1.42
	15	1.45	22	1.75	18	1.53	30	2.70	6	2.43	14	2.53	23	1.50
	31	2.47	9	3.13	11	2.40	16	2.95	14	2.57	8	3.01	16	2.97
	2	4.13	3	4.27	2	3.31	4	3.98	1	2.65	4	3.04	18	3.41

**Table CA-2 Average production and stand of Carrington plots - 2011**

Variety/ Species	Plot	plants/ ft2	EC	DM	Yield Dry T/acre	Variety/ Species	Plot	plants/ ft2	EC	DM	Yield Dry T/acre
Garrison creeping foxtail	1	29.1	4.4	56%	3.3	Revenue slender wheatgrass	1	32.5	2.7	47%	4.2
	2	9.5	5.2	37%	2.5		2	15.6	3.9	48%	5.1
	3	8.1	4.7	36%	2.9		3	10.8	3.3	47%	4.2
	4	2.0	6.0	35%	2.2		4	7.4	4.9	48%	5.7
	5	2.0	5.6	39%	1.3		5	2.7	8.2	50%	2.0
<b>Averages--&gt;</b>		<b>10.2</b>	<b>5.2</b>	<b>41%</b>	<b>2.4</b>	<b>Averages--&gt;</b>		<b>13.8</b>	<b>4.6</b>	<b>48%</b>	<b>4.2</b>
Lincoln smooth bromegrass	1	29.8	4.0	33%	1.8	Rodan western wheatgrass	1	16.3	2.3	44%	3.6
	2	16.9	4.4	53%	3.8		2	10.2	4.7	45%	3.0
	3	11.5	4.9	46%	3.3		3	19.0	3.7	48%	2.6
	4	5.4	5.3	52%	1.0		4	21.0	5.4	44%	3.1
	5	0.7	5.1	60%	1.2		5	1.4	8.2	51%	1.3
<b>Averages--&gt;</b>		<b>12.9</b>	<b>4.8</b>	<b>49%</b>	<b>2.2</b>	<b>Averages--&gt;</b>		<b>13.5</b>	<b>4.9</b>	<b>46%</b>	<b>2.7</b>
Fleet meadow bromegrass	1	20.3	2.6	42%	2.5	NewHy hybrid wheatgrass	1	37.9	3.0	45%	3.5
	2	17.6	3.8	51%	2.0		2	22.3	4.7	44%	4.0
	3	12.2	3.3	44%	2.5		3	14.9	3.9	43%	3.6
	4	6.8	4.9	53%	2.8		4	6.1	5.6	42%	3.4
	5	1.4	5.1	66%	1.2		5	2.0	9.6	47%	2.7
<b>Averages--&gt;</b>		<b>11.6</b>	<b>3.9</b>	<b>51%</b>	<b>2.2</b>	<b>Averages--&gt;</b>		<b>16.7</b>	<b>5.4</b>	<b>44%</b>	<b>3.5</b>
Mandan Canada wildrye	1	14.9	3.4	43%	3.0	AC Saltlander green wheatgrass	1	21.7	1.7	46%	3.7
	2	7.4	3.5	40%	4.1		2	18.3	4.8	45%	4.2
	3	10.2	3.0	39%	3.9		3	12.2	3.8	45%	4.3
	4	4.1	4.7	41%	3.1		4	7.4	7.0	45%	5.1
	5	1.4	4.9	41%	2.6		5	1.4	10.0	46%	2.5
<b>Averages--&gt;</b>		<b>7.6</b>	<b>3.9</b>	<b>41%</b>	<b>3.3</b>	<b>Averages--&gt;</b>		<b>12.2</b>	<b>5.5</b>	<b>45%</b>	<b>4.0</b>

Variety/ Species	Plot	plants/ ft2	EC	DM	Yield Dry T/acre	Variety/ Species	Plot	plants/ ft2	EC	DM	Yield Dry T/acre
Shoshone manystem wildrye	1	25.7	3.7	46%	1.1	Saltlander Forage Grass Mix 50% AC Saltlander gwg 25% Revenue swg 25% Courtenay tff	1	37.9	2.4	42%	4.8
	2	11.5	3.6	37%	3.4		2	33.9	4.1	42%	4.1
	3	9.5	3.8	46%	2.1		3	20.3	5.1	40%	4.1
	4	3.4	5.0	28%	2.5		4	10.8	4.6	41%	4.5
	5	1.4	5.8	44%	4.6		5	2.7	5.2	42%	3.8
<b>Averages--&gt;</b>		<b>10.3</b>	<b>4.3</b>	<b>40%</b>	<b>2.7</b>	<b>Averages--&gt;</b>		<b>21.1</b>	<b>4.3</b>	<b>41%</b>	<b>4.2</b>
Alkar tall wheatgrass	1	17.6	3.5	34%	4.7						
	2	19.0	3.5	31%	5.3						
	3	15.6	4.2	36%	3.9						
	4	12.2	5.7	31%	7.7						
	5	10.8	10.7	36%	5.7						
<b>Averages--&gt;</b>		<b>15.0</b>	<b>5.5</b>	<b>34%</b>	<b>5.4</b>						

**Table CA-3 Average forage quality of Carrington plots - 2011**

Variety	Plot	CP	HDP	AP	NFC	ADF	NDF	CF	TDN EST.	NEL	NEM	NEG	DDM	(Ca)	(P)	(K)	(Mg)	RFV
<b>Garrison creeping foxtail</b>	1	5.9	0.67	5.7	18.9	44.2	63.9	35.4	52.2	0.53	0.47	0.22	54.5	0.47	0.20	1.75	0.17	79
	2	7.9	0.72	7.8	14.8	44.3	66.0	35.4	52.1	0.53	0.48	0.23	54.4	0.47	0.23	1.87	0.22	77
	3	8.7	0.69	8.7	16.5	42.7	63.5	34.2	53.9	0.55	0.50	0.25	55.7	0.51	0.25	2.09	0.21	82
	4	12.2	0.82	12.2	12.3	41.9	64.2	33.5	54.8	0.56	0.52	0.26	56.3	0.57	0.27	1.98	0.26	82
	5	5.8	0.67	5.6	16.6	45.3	66.3	36.2	50.9	0.51	0.46	0.21	53.6	0.41	0.20	1.81	0.16	75
<b>Average--&gt;</b>		8.1	0.71	8.0	15.8	43.7	64.8	34.9	52.8	0.53	0.48	0.23	54.9	0.48	0.23	1.90	0.20	79
<b>Lincoln smooth brome</b>	1	8.7	0.58	8.7	19.6	39.6	60.4	31.7	57.4	0.59	0.56	0.30	58.0	0.60	0.18	1.51	0.23	89
	2	7.6	0.51	7.6	17.7	39.5	63.4	31.6	57.5	0.59	0.56	0.30	58.1	0.42	0.13	1.12	0.19	85
	3	8.4	0.57	8.4	17.1	40.0	63.1	32.0	56.9	0.58	0.55	0.30	57.7	0.49	0.17	1.32	0.23	85
	4	5.2	0.54	5.2	19.5	40.0	64.0	32.0	57.0	0.58	0.55	0.29	57.7	0.35	0.11	1.00	0.15	84
	5	6.3	0.50	6.3	22.2	37.8	60.1	30.2	59.5	0.61	0.59	0.33	59.5	0.40	0.12	0.94	0.17	92
<b>Average--&gt;</b>		7.3	0.54	7.2	19.2	39.4	62.2	31.5	57.6	0.59	0.56	0.30	58.2	0.45	0.14	1.17	0.19	87
<b>Fleet meadow brome</b>	1	7.6	0.57	7.6	15.8	43.2	65.2	34.6	53.3	0.54	0.49	0.24	55.2	0.45	0.18	1.57	0.20	79
	2	5.8	0.64	5.6	16.1	42.2	66.9	33.8	54.4	0.55	0.51	0.26	56.0	0.35	0.15	1.28	0.16	78
	3	3.9	0.37	3.9	8.0	20.5	32.5	16.4	27.9	0.29	0.27	0.14	28.5	0.25	0.08	0.57	0.11	41
	4	7.4	0.70	7.4	14.9	40.8	66.4	32.6	56.0	0.57	0.54	0.28	57.1	0.40	0.18	1.30	0.19	80
	5	6.5	0.69	6.4	14.6	41.0	67.6	32.8	55.8	0.57	0.53	0.28	57.0	0.32	0.16	1.26	0.18	79
<b>Average--&gt;</b>		7.8	0.74	7.7	17.3	46.9	74.6	37.6	61.8	0.63	0.58	0.30	63.4	0.44	0.19	1.49	0.21	89
<b>Mandan Canada wildrye</b>	1	5.9	0.52	5.9	13.3	43.6	69.5	34.8	52.9	0.54	0.49	0.24	55.0	0.36	0.17	1.26	0.20	74
	2	9.0	0.56	9.0	10.2	43.3	69.4	34.6	53.2	0.54	0.50	0.24	55.2	0.45	0.20	1.45	0.24	74
	3	7.4	0.54	7.4	13.8	43.2	67.5	34.5	53.4	0.54	0.49	0.24	55.3	0.43	0.18	1.34	0.20	76
	4	8.6	0.59	8.6	10.5	42.7	69.6	34.1	53.9	0.55	0.51	0.25	55.7	0.43	0.19	1.40	0.21	75
	5	8.5	0.57	8.5	10.7	43.1	69.5	34.4	53.5	0.54	0.50	0.24	55.4	0.40	0.17	1.35	0.21	74
<b>Average--&gt;</b>		7.9	0.55	7.9	11.7	43.1	69.1	34.5	53.4	0.54	0.49	0.24	55.3	0.41	0.18	1.36	0.21	75
<b>Shoshone manystem wildrye</b>	1	6.7	0.61	6.7	15.4	42.6	66.5	34.1	53.9	0.55	0.51	0.25	55.7	0.33	0.18	1.87	0.13	78
	2	11.9	0.73	11.9	11.4	42.2	65.5	33.8	54.4	0.55	0.51	0.26	56.0	0.52	0.26	2.22	0.23	80
	3	6.1	0.71	5.9	13.1	44.3	69.5	35.4	52.1	0.53	0.47	0.23	54.4	0.35	0.19	1.93	0.14	73
	4	11.8	0.75	11.8	10.0	41.3	66.9	33.1	55.4	0.56	0.53	0.27	56.7	0.49	0.23	2.09	0.21	80
	5	10.1	0.75	10.1	7.4	44.9	71.2	35.9	51.4	0.52	0.47	0.22	53.9	0.43	0.25	2.24	0.22	71
<b>Average--&gt;</b>		9.3	0.71	9.3	11.5	43.1	67.9	34.5	53.4	0.54	0.50	0.24	55.3	0.42	0.22	2.07	0.18	76

Variety	Plot	CP	HDP	AP	NFC	ADF	NDF	CF	TDN EST.	NEL	NEM	NEG	DDM	(Ca)	(P)	(K)	(Mg)	RFV
Alkar tall wheatgrass	1	7.2	0.53	7.2	7.0	47.7	74.5	38.1	48.2	0.48	0.41	0.17	51.8	0.26	0.22	1.86	0.18	65
	2	8.9	0.52	8.9	6.5	47.5	73.3	38.0	48.4	0.49	0.42	0.17	51.9	0.30	0.26	2.18	0.21	66
	3	5.6	0.52	5.5	6.8	48.5	76.3	38.8	47.2	0.47	0.40	0.15	51.1	0.19	0.20	1.79	0.15	62
	4	11.9	0.56	11.9	6.3	45.6	70.4	36.5	50.5	0.51	0.45	0.20	53.4	0.39	0.29	2.30	0.28	71
	5	9.3	0.50	9.3	6.5	45.8	72.9	36.6	50.4	0.51	0.45	0.20	53.2	0.29	0.26	2.09	0.22	68
Average-->	8.6	0.53	8.6	13.2	47.0	73.5	37.6	48.9	0.49	0.42	0.18	52.3	0.28	0.24	2.04	0.21	66	
Revenue slender wheatgrass	1	6.3	0.69	6.2	7.0	47.9	75.4	38.3	48.0	0.48	0.41	0.16	51.6	0.30	0.14	1.20	0.15	64
	2	9.6	0.71	9.6	8.1	44.4	70.9	35.5	52.0	0.53	0.47	0.22	54.3	0.41	0.20	1.48	0.22	71
	3	7.6	0.69	7.6	5.3	46.1	73.0	36.9	50.0	0.50	0.44	0.19	53.0	0.37	0.15	1.32	0.18	68
	4	8.3	0.70	8.2	8.2	45.9	72.2	36.7	50.2	0.51	0.45	0.20	53.2	0.38	0.17	1.21	0.18	69
	5	9.4	0.66	9.4	7.4	43.5	71.8	34.8	53.0	0.54	0.49	0.24	55.0	0.38	0.16	1.25	0.21	71
Average-->	8.3	0.69	8.2	7.2	45.5	72.7	36.4	50.6	0.51	0.45	0.20	53.4	0.37	0.16	1.29	0.19	69	
Rodan western wheatgrass	1	8.7	0.56	8.7	12.8	42.8	67.2	34.3	53.7	0.55	0.50	0.25	55.5	0.42	0.20	1.49	0.19	77
	2	9.7	0.52	9.7	12.0	41.1	67.0	32.9	55.7	0.57	0.53	0.28	56.9	0.35	0.18	1.35	0.19	79
	3	8.2	0.52	8.2	14.6	41.2	65.9	32.9	55.6	0.57	0.53	0.27	56.8	0.42	0.17	1.25	0.17	80
	4	8.5	0.56	8.5	14.3	41.5	65.9	33.2	55.2	0.57	0.52	0.27	56.6	0.44	0.19	1.35	0.22	80
	5	10.2	0.48	10.2	14.7	38.7	63.8	31.0	58.4	0.60	0.57	0.32	58.7	0.46	0.18	1.20	0.24	86
Average-->	9.1	0.53	9.1	13.7	41.1	66.0	32.9	55.7	0.57	0.53	0.28	56.9	0.42	0.18	1.33	0.20	80	
NewHy hybrid wheatgrass	1	6.7	0.59	6.7	15.7	44.1	66.3	35.3	52.3	0.53	0.48	0.23	54.6	0.42	0.19	1.55	0.18	77
	2	6.9	0.59	6.9	17.3	42.7	64.4	34.1	53.9	0.55	0.51	0.25	55.7	0.43	0.18	1.49	0.19	80
	3	10.8	0.62	10.8	12.6	41.8	65.3	33.5	54.9	0.56	0.52	0.26	56.3	0.51	0.24	1.89	0.25	81
	4	10.5	0.61	10.5	13.6	41.7	64.6	33.4	55.0	0.56	0.52	0.27	56.4	0.51	0.24	1.75	0.26	81
	5	8.6	0.59	8.6	14.9	41.7	65.2	33.3	55.1	0.56	0.52	0.27	56.5	0.40	0.20	1.58	0.20	81
Average-->	8.7	0.60	8.7	14.8	42.4	65.2	33.9	54.2	0.55	0.51	0.25	55.9	0.45	0.21	1.65	0.22	80	
AC Saltlander green wheatgrass	1	6.9	0.68	6.9	13.2	45.0	68.6	36.0	51.3	0.52	0.46	0.21	53.9	0.39	0.19	1.61	0.18	73
	2	6.9	0.53	6.9	20.3	40.2	61.5	32.2	56.7	0.58	0.55	0.29	57.6	0.49	0.17	1.36	0.20	87
	3	9.4	0.65	9.4	16.3	41.2	63.0	32.9	55.6	0.57	0.53	0.27	56.8	0.56	0.22	1.59	0.24	84
	4	10.6	0.60	10.6	16.0	39.4	62.1	31.5	57.6	0.59	0.56	0.31	58.2	0.56	0.21	1.44	0.26	87
	5	10.1	0.57	10.1	14.0	40.6	64.6	32.5	56.2	0.57	0.54	0.29	57.3	0.48	0.23	1.56	0.24	83
Average-->	8.8	0.60	8.8	16.0	41.3	63.9	33.0	55.5	0.56	0.53	0.27	56.7	0.50	0.20	1.51	0.22	83	

Variety	Plot	CP	HDP	AP	NFC	ADF	NDF	CF	TDN EST.	NEL	NEM	NEG	DDM	(Ca)	(P)	(K)	(Mg)	RFV
<b>Saltlander forage mix</b>	1	7.8	0.63	7.8	16.1	42.4	64.8	33.9	54.2	0.55	0.51	0.25	55.9	0.49	0.20	1.54	0.21	80
	2	9.5	0.70	9.5	12.9	42.4	66.3	33.9	54.2	0.55	0.51	0.26	55.9	0.50	0.22	1.68	0.24	78
	3	11.6	0.69	11.6	13.1	40.8	64.0	32.6	56.0	0.57	0.54	0.28	57.1	0.59	0.25	1.85	0.31	83
	4	11.5	0.67	11.5	12.8	40.9	64.3	32.8	55.9	0.57	0.53	0.28	57.0	0.55	0.24	1.68	0.30	82
	5	10.8	0.55	10.8	14.4	39.8	63.4	31.8	57.2	0.59	0.55	0.30	57.9	0.48	0.23	1.69	0.27	85
<b>Average--&gt;</b>		10.3	0.65	10.3	13.9	41.3	64.6	33.0	55.5	0.57	0.53	0.27	56.8	0.52	0.22	1.69	0.27	82

**Table CA-4. Average production of Carrington plots – 2012**

Variety & Species	Plot	EC 1:1 @ 3"	EC 1:1 @6"	DM	Yield Dry T/A	Variety & Species	Plot	EC 1:1 @ 3"	EC 1:1 @6"	DM	Yield Dry T/A
<b>Garrison creeping foxtail</b>	1	4.11	5.07	0.56	2.98	<b>Revenue slender wheatgrass</b>	1	3.01	3.40	0.55	2.83
	2	5.98	5.44	0.59	2.50		2	5.92	5.95	0.57	3.31
	3	6.27	5.71	0.62	2.46		3	4.45	5.47	0.59	3.08
	4	5.23	4.48	0.59	2.46		4	6.54	6.43	0.56	3.11
	5	5.04	5.85	0.46	2.41		5	7.13	8.99	0.57	2.94
<b>Average-&gt;</b>		<b>5.33</b>	<b>5.31</b>	<b>0.57</b>	<b>2.56</b>	<b>Average-&gt;</b>		<b>5.41</b>	<b>6.05</b>	<b>0.57</b>	<b>3.05</b>
<b>Lincoln smooth bromegrass</b>	1	4.49	4.52	0.58	2.67	<b>Rodan western wheatgrass</b>	1	2.82	4.18	0.58	2.78
	2	6.00	5.81	0.60	2.70		2	5.14	6.00	0.60	2.92
	3	5.69	5.36	0.68	2.80		3	6.85	6.74	0.56	2.55
	4	3.98	4.20	0.58	2.60		4	5.78	6.41	0.63	3.36
	5	6.16	3.72	0.79	1.43		5	8.36	6.82	0.60	2.52
<b>Average-&gt;</b>		<b>5.26</b>	<b>4.72</b>	<b>0.65</b>	<b>2.44</b>	<b>Average-&gt;</b>		<b>5.79</b>	<b>6.03</b>	<b>0.59</b>	<b>2.82</b>
<b>Fleet meadow bromegrass</b>	1	3.57	3.88	0.68	3.13	<b>NewHy hybrid wheatgrass</b>	1	2.14	2.67	0.63	2.98
	2	4.96	5.37	0.70	2.64		2	4.89	5.65	0.65	3.17
	3	5.78	4.78	0.86	1.54		3	5.40	6.29	0.57	2.94
	4	4.79	4.46	0.75	1.42		4	6.54	5.38	0.63	3.20
	5	5.70	4.14	0.87	1.42		5	9.66	10.04	0.60	2.71
<b>Average-&gt;</b>		<b>4.96</b>	<b>4.52</b>	<b>0.77</b>	<b>2.03</b>	<b>Average-&gt;</b>		<b>5.73</b>	<b>6.00</b>	<b>0.62</b>	<b>3.00</b>
<b>Mandan Canada wildrye</b>	1	4.43	4.13	0.51	2.76	<b>AC Saltlander green wheatgrass</b>	1	2.31	2.97	0.60	2.81
	2	4.95	5.15	0.58	3.31		2	5.65	5.71	0.62	3.05
	3	4.06	4.55	0.65	3.13		3	7.33	7.16	0.58	3.29
	4	5.49	5.81	0.61	1.63		4	7.02	5.35	0.58	3.10
	5	5.75	4.74	0.65	1.26		5	7.38	7.69	0.61	1.47
<b>Average-&gt;</b>		<b>4.94</b>	<b>4.88</b>	<b>0.60</b>	<b>2.42</b>	<b>Average-&gt;</b>		<b>5.94</b>	<b>5.78</b>	<b>0.59</b>	<b>2.75</b>

Variety & Species	Plot	EC 1:1 @ 3"	EC 1:1 @6"	DM	Yield Dry T/A		Variety & Species	Plot	EC 1:1 @ 3"	EC 1:1 @6"	DM	Yield Dry T/A
<b>Shoshone manystem wildrye</b>	1	2.86	4.07	0.56	2.74		<b>Saltlander forage mix</b>	1	2.26	2.39	0.58	2.90
	2	6.16	7.21	0.55	3.62			2	4.05	6.56	0.63	3.43
	3	4.75	7.25	0.52	2.53			3	7.26	5.07	0.60	3.17
	4	5.31	5.90	0.57	3.26			4	8.54	8.38	0.59	3.28
	5	7.61	7.61	0.55	3.29			5	8.59	7.59	0.64	3.52
<b>Average-&gt;</b>		<b>5.34</b>	<b>6.41</b>	<b>0.55</b>	<b>3.09</b>		<b>Average-&gt;</b>		<b>6.14</b>	<b>6.00</b>	<b>0.61</b>	<b>3.26</b>
<b>Alkar tall wheatgrass</b>	1	2.89	1.90	0.43	3.37							
	2	5.42	5.55	0.56	3.67							
	3	5.80	7.82	0.51	3.05							
	4	5.11	5.15	0.43	2.92							
	5	7.51	8.48	0.43	2.47							
<b>Average-&gt;</b>		<b>5.35</b>	<b>5.78</b>	<b>0.47</b>	<b>3.10</b>							

**Table CA-5. Average forage quality of Carrington plots – 2012**

Variety & Species	Plot	CP	HDP	AP	NFC	ADF	NDF	CF	TDN	NEL	NEM	NEG	DDM	Ca	P	K	Mg	RFV
Garrison creeping foxtail	1	4.0	0.59	3.7	23.4	41.6	61.3	33.3	55.1	0.56	0.52	0.27	56.5	0.51	0.13	1.15	0.11	86
	2	2.3	0.54	1.9	23.9	41.4	62.5	33.1	55.3	0.56	0.52	0.27	56.6	0.36	0.10	0.90	0.04	84
	3	3.2	0.53	2.9	25.7	39.1	59.8	31.3	58.0	0.60	0.57	0.31	58.5	0.48	0.10	0.83	0.08	92
	4	3.5	0.61	3.1	19.5	42.8	65.7	34.2	53.8	0.55	0.50	0.25	55.6	0.37	0.11	1.11	0.08	80
	5	5.1	0.55	5.0	20.3	42.4	63.3	33.9	54.2	0.55	0.51	0.25	55.9	0.39	0.15	1.25	0.10	82
<b>Average-&gt;</b>		<b>3.6</b>	<b>0.56</b>	<b>3.3</b>	<b>22.5</b>	<b>41.5</b>	<b>62.5</b>	<b>33.2</b>	<b>55.3</b>	<b>0.56</b>	<b>0.52</b>	<b>0.27</b>	<b>56.6</b>	<b>0.42</b>	<b>0.12</b>	<b>1.05</b>	<b>0.08</b>	<b>85</b>
Lincoln smooth bromegrass	1	5.3	0.51	5.3	24.9	38.7	58.5	30.9	58.5	0.60	0.57	0.32	58.8	0.57	0.09	0.82	0.15	93
	2	4.8	0.55	4.7	22.3	38.8	61.7	31.0	58.3	0.60	0.57	0.31	58.7	0.42	0.09	0.74	0.11	89
	3	4.0	0.51	3.9	24.9	39.0	59.8	31.2	58.1	0.60	0.57	0.31	58.6	0.51	0.07	0.79	0.11	92
	4	6.5	0.52	6.5	20.8	38.9	61.4	31.1	58.2	0.59	0.57	0.31	58.6	0.45	0.12	1.02	0.13	89
	5	4.4	0.47	4.4	22.1	41.1	62.2	32.9	55.6	0.57	0.53	0.27	56.9	0.35	0.10	0.83	0.11	85
<b>Average-&gt;</b>		<b>5.0</b>	<b>0.51</b>	<b>4.9</b>	<b>23.0</b>	<b>39.3</b>	<b>60.7</b>	<b>31.4</b>	<b>57.8</b>	<b>0.59</b>	<b>0.56</b>	<b>0.30</b>	<b>58.3</b>	<b>0.46</b>	<b>0.09</b>	<b>0.84</b>	<b>0.12</b>	<b>90</b>
Fleet meadow bromegrass	1	4.5	0.69	4.1	17.7	42.8	66.5	34.3	53.7	0.55	0.50	0.25	55.5	0.43	0.14	1.24	0.12	78
	2	4.7	0.70	4.4	18.3	42.2	65.7	33.8	54.4	0.55	0.51	0.26	56.0	0.53	0.11	1.10	0.14	80
	3	1.4	0.37	1.1	7.1	21.8	35.8	17.4	26.4	0.27	0.25	0.12	27.5	0.12	0.04	0.47	0.03	36
	4	3.7	0.70	3.2	14.3	43.3	70.7	34.7	53.1	0.54	0.49	0.24	55.1	0.28	0.10	0.79	0.09	73
	5	2.6	0.58	2.1	17.3	41.8	68.8	33.5	54.9	0.56	0.52	0.27	56.3	0.30	0.08	0.66	0.09	76
<b>Average-&gt;</b>		<b>3.4</b>	<b>0.60</b>	<b>3.0</b>	<b>15.0</b>	<b>38.4</b>	<b>61.5</b>	<b>30.7</b>	<b>48.5</b>	<b>0.49</b>	<b>0.45</b>	<b>0.22</b>	<b>50.1</b>	<b>0.33</b>	<b>0.09</b>	<b>0.85</b>	<b>0.09</b>	<b>69</b>
Mandan Canada wildrye	1	4.5	0.48	4.5	17.5	41.4	66.7	33.1	55.4	0.56	0.53	0.27	56.7	0.45	0.10	0.80	0.16	80
	2	4.6	0.45	4.6	18.2	41.1	65.9	32.9	55.7	0.57	0.53	0.28	56.9	0.41	0.09	0.75	0.15	80
	3	4.3	0.52	4.1	18.1	41.4	66.4	33.1	55.4	0.56	0.52	0.27	56.7	0.38	0.09	0.80	0.13	79
	4	5.5	0.47	5.5	18.2	41.2	65.0	33.0	55.6	0.57	0.53	0.28	56.8	0.42	0.12	0.89	0.16	82
	5	5.1	0.42	5.1	21.3	39.8	62.3	31.8	57.2	0.59	0.56	0.30	57.9	0.46	0.12	0.89	0.16	87
<b>Average-&gt;</b>		<b>4.8</b>	<b>0.47</b>	<b>4.7</b>	<b>18.6</b>	<b>41.0</b>	<b>65.3</b>	<b>32.8</b>	<b>55.9</b>	<b>0.57</b>	<b>0.53</b>	<b>0.28</b>	<b>57.0</b>	<b>0.42</b>	<b>0.10</b>	<b>0.82</b>	<b>0.15</b>	<b>82</b>

Variety & Species	Plot	CP	HDP	AP	NFC	ADF	NDF	CF	TDN	NEL	NEM	NEG	DDM	Ca	P	K	Mg	RFV
Shoshone manystem wildrye	1	5.1	0.71	4.8	15.1	43.2	68.5	34.5	53.3	0.54	0.49	0.24	55.3	0.38	0.15	1.49	0.10	75
	2	8.0	0.80	7.9	9.8	45.7	70.9	36.5	50.5	0.51	0.45	0.20	53.3	0.36	0.20	1.88	0.13	70
	3	7.7	0.73	7.5	13.3	42.3	67.7	33.8	54.4	0.55	0.51	0.26	56.0	0.46	0.17	1.61	0.15	77
	4	4.8	0.70	4.5	14.0	43.8	69.8	35.1	52.6	0.53	0.48	0.23	54.8	0.30	0.14	1.35	0.09	73
	5	7.3	0.70	7.2	12.7	42.2	68.7	33.8	54.4	0.56	0.51	0.26	56.0	0.38	0.19	1.66	0.15	76
<b>Average-&gt;</b>		<b>6.6</b>	<b>0.73</b>	<b>6.4</b>	<b>13.0</b>	<b>43.4</b>	<b>69.1</b>	<b>34.7</b>	<b>53.0</b>	<b>0.54</b>	<b>0.49</b>	<b>0.24</b>	<b>55.1</b>	<b>0.38</b>	<b>0.17</b>	<b>1.59</b>	<b>0.12</b>	<b>74</b>
Alkar tall wheatgrass	1	5.5	0.56	5.4	8.5	47.5	74.7	38.0	48.4	0.49	0.42	0.17	51.9	0.19	0.18	1.49	0.12	65
	2	3.8	0.53	3.6	12.4	46.1	72.5	36.9	49.9	0.51	0.44	0.19	53.0	0.20	0.12	1.10	0.10	68
	3	4.4	0.53	4.2	13.3	45.2	71.0	36.2	51.0	0.52	0.46	0.21	53.7	0.23	0.13	1.12	0.10	70
	4	4.7	0.57	4.5	9.8	48.0	74.2	38.4	47.8	0.48	0.41	0.16	51.5	0.19	0.15	1.38	0.10	65
	5	7.9	0.50	7.8	9.6	44.2	71.2	35.4	52.1	0.53	0.47	0.23	54.4	0.24	0.19	1.47	0.14	72
<b>Average-&gt;</b>		<b>5.2</b>	<b>0.54</b>	<b>5.1</b>	<b>10.7</b>	<b>46.2</b>	<b>72.7</b>	<b>37.0</b>	<b>49.9</b>	<b>0.50</b>	<b>0.44</b>	<b>0.19</b>	<b>52.9</b>	<b>0.21</b>	<b>0.15</b>	<b>1.31</b>	<b>0.11</b>	<b>68</b>
Revenue slender wheatgrass	1	4.7	0.62	4.5	15.4	41.0	68.6	32.8	55.8	0.57	0.54	0.28	57.0	0.41	0.10	0.74	0.12	77
	2	6.4	0.62	6.3	12.4	41.5	70.0	33.2	55.2	0.56	0.53	0.27	56.6	0.37	0.12	0.78	0.13	75
	3	5.2	0.65	5.0	14.3	41.6	69.2	33.2	55.2	0.56	0.52	0.27	56.5	0.39	0.10	0.73	0.12	76
	4	6.5	0.62	6.5	13.4	41.0	68.8	32.8	55.8	0.57	0.53	0.28	57.0	0.37	0.13	0.97	0.14	77
	5	8.6	0.57	8.6	13.5	39.3	66.7	31.5	57.7	0.59	0.56	0.30	58.3	0.40	0.15	0.98	0.18	81
<b>Average-&gt;</b>		<b>6.3</b>	<b>0.62</b>	<b>6.2</b>	<b>13.8</b>	<b>40.9</b>	<b>68.6</b>	<b>32.7</b>	<b>55.9</b>	<b>0.57</b>	<b>0.53</b>	<b>0.28</b>	<b>57.1</b>	<b>0.38</b>	<b>0.12</b>	<b>0.84</b>	<b>0.14</b>	<b>77</b>
Rodan western wheatgrass	1	5.0	0.47	5.0	21.2	38.7	62.6	31.0	58.4	0.60	0.57	0.31	58.8	0.46	0.11	0.73	0.13	87
	2	5.8	0.56	5.7	19.6	38.5	63.3	30.8	58.6	0.60	0.58	0.32	58.9	0.46	0.11	0.65	0.14	87
	3	8.1	0.46	8.1	18.3	37.7	62.2	30.2	59.5	0.61	0.59	0.33	59.5	0.49	0.14	0.96	0.19	89
	4	7.4	0.57	7.4	17.3	38.4	64.0	30.7	58.7	0.60	0.58	0.32	59.0	0.42	0.12	0.76	0.13	86
	5	9.0	0.52	9.0	16.2	38.4	63.5	30.7	58.8	0.60	0.58	0.32	59.0	0.49	0.18	1.17	0.20	87
<b>Average-&gt;</b>		<b>7.1</b>	<b>0.52</b>	<b>7.0</b>	<b>18.5</b>	<b>38.4</b>	<b>63.1</b>	<b>30.7</b>	<b>58.8</b>	<b>0.60</b>	<b>0.58</b>	<b>0.32</b>	<b>59.0</b>	<b>0.46</b>	<b>0.13</b>	<b>0.85</b>	<b>0.16</b>	<b>87</b>

Variety & Species	Plot	CP	HDP	AP	NFC	ADF	NDF	CF	TDN	NEL	NEM	NEG	DDM	Ca	P	K	Mg	RFV
<b>NewHy hybrid wheatgrass</b>	1	3.6	0.44	3.4	25.7	38.1	59.4	30.5	59.1	0.60	0.58	0.32	59.2	0.44	0.08	0.71	0.11	93
	2	4.2	0.54	4.0	23.1	39.1	61.4	31.3	57.9	0.59	0.57	0.31	58.4	0.46	0.10	0.79	0.11	88
	3	4.5	0.49	4.5	23.2	38.8	60.9	31.1	58.3	0.60	0.57	0.31	58.7	0.42	0.10	0.81	0.12	90
	4	3.7	0.51	3.5	22.7	39.3	62.3	31.4	57.8	0.59	0.56	0.31	58.3	0.40	0.09	0.82	0.10	87
	5	6.7	0.51	6.6	21.0	37.8	61.0	30.2	59.5	0.61	0.59	0.33	59.5	0.48	0.13	0.97	0.18	91
<b>Average-&gt;</b>		<b>4.5</b>	<b>0.49</b>	<b>4.4</b>	<b>23.1</b>	<b>38.6</b>	<b>61.0</b>	<b>30.9</b>	<b>58.5</b>	<b>0.60</b>	<b>0.57</b>	<b>0.31</b>	<b>58.8</b>	<b>0.44</b>	<b>0.10</b>	<b>0.82</b>	<b>0.12</b>	<b>90</b>
<b>AC Saltlander green wheatgrass</b>	1	3.8	0.50	3.6	24.4	37.9	60.5	30.3	59.4	0.61	0.59	0.33	59.4	0.44	0.10	0.77	0.09	91
	2	4.2	0.48	4.1	24.4	37.7	60.0	30.2	59.5	0.61	0.59	0.33	59.5	0.48	0.10	0.81	0.11	92
	3	6.8	0.47	6.8	20.1	38.3	61.8	30.7	58.8	0.61	0.58	0.32	59.0	0.39	0.13	1.07	0.14	89
	4	6.9	0.52	6.9	20.2	38.5	61.7	30.8	58.6	0.60	0.58	0.32	58.9	0.43	0.13	1.03	0.15	89
	5	6.8	0.53	6.8	21.8	36.9	60.1	29.5	60.5	0.62	0.60	0.34	60.2	0.50	0.14	0.91	0.19	93
<b>Average-&gt;</b>		<b>5.7</b>	<b>0.50</b>	<b>5.6</b>	<b>22.2</b>	<b>37.9</b>	<b>60.8</b>	<b>30.3</b>	<b>59.4</b>	<b>0.61</b>	<b>0.59</b>	<b>0.33</b>	<b>59.4</b>	<b>0.44</b>	<b>0.12</b>	<b>0.92</b>	<b>0.14</b>	<b>91</b>
<b>Saltlander forage mix</b>	1	4.6	0.53	4.4	23.4	39.2	60.7	31.4	57.8	0.59	0.56	0.31	58.3	0.48	0.13	1.14	0.13	89
	2	4.7	0.51	4.6	24.1	38.0	59.9	30.4	59.3	0.61	0.59	0.33	59.3	0.48	0.10	0.87	0.13	92
	3	5.4	0.52	5.4	20.0	39.1	63.2	31.3	57.9	0.59	0.57	0.31	58.4	0.35	0.12	0.95	0.12	86
	4	8.6	0.52	8.6	18.9	36.3	61.2	29.0	61.2	0.63	0.61	0.35	60.7	0.46	0.15	1.05	0.17	92
	5	7.6	0.52	7.5	18.7	38.5	62.4	30.8	58.6	0.60	0.58	0.32	58.9	0.47	0.15	1.14	0.17	88
<b>Average-&gt;</b>		<b>6.2</b>	<b>0.52</b>	<b>6.1</b>	<b>21.0</b>	<b>38.2</b>	<b>61.5</b>	<b>30.6</b>	<b>59.0</b>	<b>0.60</b>	<b>0.58</b>	<b>0.32</b>	<b>59.1</b>	<b>0.45</b>	<b>0.13</b>	<b>1.03</b>	<b>0.14</b>	<b>90</b>

**Table CA-6. Carrington production average, 2011-2013**

Species	Plot	EC 1:1 @ 3"	EC 1:1 @6"	DM	Yield Dry T/A	Species	Plot	EC 1:1 @ 3"	EC 1:1 @6"	DM	Yield Dry T/A
<b>Garrison creeping foxtail</b>	1	5.02	0.00	50%	2.37	<b>Revenue slender wheatgrass</b>	1	1.07	0.00	58%	2.44
	2	5.07	0.00	46%	2.22		2	2.32	0.00	58%	2.64
	3	6.22	0.00	49%	2.24		3	4.31	0.00	57%	2.49
	4	6.99	0.00	47%	2.55		4	3.15	0.00	57%	2.60
	5	6.31	0.00	46%	2.31		5	3.46	0.00	56%	2.72
<b>Averages--&gt;</b>		5.92	0.00	48%	2.34	<b>Averages--&gt;</b>		2.86	0.00	57%	2.58
<b>Lincoln smooth brome</b>	1	5.97	0.00	57%	3.04	<b>Rodan western wheatgrass</b>	1	0.74	0.00	56%	2.45
	2	5.81	0.00	42%	1.89		2	1.70	0.00	57%	2.59
	3	5.25	0.00	54%	2.34		3	2.68	0.00	55%	2.36
	4	2.78	0.00	56%	2.82		4	5.26	0.00	55%	2.53
	5	4.99	0.00	63%	1.43		5	3.38	0.00	54%	2.60
<b>Averages--&gt;</b>		4.96	0.00	54%	2.30	<b>Averages--&gt;</b>		2.75	0.00	55%	2.50
<b>Fleet meadow brome</b>	1	4.80	0.00	57%	2.44	<b>NewHy hybrid wheatgrass</b>	1	1.71	0.00	54%	2.39
	2	3.79	0.00	72%	2.88		2	3.45	0.00	56%	2.67
	3	6.13	0.00	89%	0.21		3	4.69	0.00	54%	2.69
	4	2.78	0.00	80%	1.24		4	5.03	0.00	54%	2.58
	5	2.31	0.00	71%	1.14		5	4.01	0.00	53%	3.00
<b>Averages--&gt;</b>		3.96	0.00	74%	1.58	<b>Averages--&gt;</b>		3.78	0.00	54%	2.67
<b>Mandan Canada wildrye</b>	1	2.18	0.00	52%	2.27	<b>AC Saltlander green wheatgrass</b>	1	1.07	0.00	53%	2.31
	2	3.77	0.00	51%	2.29		2	3.49	0.00	53%	2.70
	3	4.03	0.00	50%	1.94		3	3.53	0.00	54%	2.83
	4	3.68	0.00	51%	2.36		4	5.29	0.00	53%	2.77
	5	2.48	0.00	63%	1.53		5	4.21	0.00	55%	3.11
<b>Averages--&gt;</b>		3.23	0.00	53%	2.08	<b>Averages--&gt;</b>		3.52	0.00	54%	2.74

Species	Plot	EC 1:1 @ 3"	EC 1:1 @6"	DM	Yield Dry T/A		Species	Plot	EC 1:1 @ 3"	EC 1:1 @6"	DM	Yield Dry T/A
<b>Shoshone Manystem Wildrye</b>	1	1.12	0.00	54%	2.28		<b>Saltlander Forage Mix</b>	1	0.90	0.00	40%	1.80
	2	1.29	0.00	52%	2.42			2	1.13	0.00	55%	2.83
	3	4.17	0.00	52%	2.48			3	3.06	0.00	56%	2.97
	4	5.82	0.00	50%	2.49			4	4.08	0.00	52%	2.89
	5	4.81	0.00	48%	2.62			5	6.39	0.00	53%	3.13
<b>Averages--&gt;</b>		3.44	0.00	51%	2.46		<b>Averages--&gt;</b>	3.11	0.00	51%	2.72	
<b>Alkar Tall Wheatgrass</b>	1	1.00	0.00	44%	2.50							
	2	3.69	0.00	45%	2.64							
	3	2.43	0.00	47%	2.93							
	4	2.96	0.00	42%	3.05							
	5	1.90	0.00	44%	3.09							
<b>Averages--&gt;</b>		2.39	0.00	44%	2.84							

**Table CA-7. 3-year average forage production at Carrington, 2011-2013**

Variety/Species	Clip 1		Clip 2		Clip 3		Clip 4		Clip 5		AVG EC @ 2" dS/m	AVG Yield T/A
	EC @ 2" dS/m	Dry Tons/Acre										
Garrison creeping foxtail	4.5	<b>2.9</b>	5.1	2.4	5.7	2.3	6.2	2.2	5.8	1.9	<b>5.4</b>	<b>2.4</b>
Lincoln smooth brome	4.6	2.4	5.3	<b>3.4</b>	4.9	2.8	4.3	2.1	5.4	1.7	<b>4.9</b>	<b>2.5</b>
Fleet meadow brome	3.6	2.5	3.9	2.6	4.7	1.4	4.1	2.0	4.2	1.6	<b>4.1</b>	<b>2.0</b>
Mandan Canada wildrye	3.4	2.5	4.0	3.6	3.6	3.1	4.4	2.4	4.3	2.0	<b>4.0</b>	<b>2.7</b>
Shoshone beardless wildrye	2.5	2.3	4.0	3.0	3.9	1.9	5.5	2.2	6.1	<b>3.2</b>	<b>4.4</b>	<b>2.5</b>
Alkar tall wheatgrass	2.6	<b>3.6</b>	4.0	<b>4.1</b>	4.5	<b>3.6</b>	5.0	<b>4.3</b>	6.6	<b>4.1</b>	<b>4.6</b>	<b>3.9</b>
Revenue slender wheatgrass	2.3	<b>3.0</b>	3.8	<b>3.8</b>	3.9	<b>3.1</b>	4.8	<b>3.3</b>	6.4	<b>2.6</b>	<b>4.2</b>	<b>3.2</b>
Rodan western wheatgrass	1.9	2.8	3.8	2.7	4.3	2.2	5.2	2.6	7.0	2.3	<b>4.5</b>	<b>2.5</b>
NewHy hybrid wheatgrass	2.3	<b>3.2</b>	4.2	<b>3.3</b>	4.4	<b>2.9</b>	5.7	<b>3.0</b>	7.8	<b>3.1</b>	<b>4.9</b>	<b>3.1</b>
AC Saltlander green wheatgrass	1.9	<b>3.2</b>	4.3	<b>3.3</b>	4.8	<b>3.6</b>	6.5	<b>3.8</b>	7.3	2.5	<b>5.0</b>	<b>3.3</b>
Saltlander Forage Grass Mix	2.0	<b>3.6</b>	3.1	<b>3.4</b>	4.8	<b>3.5</b>	5.9	<b>3.6</b>	7.6	<b>3.7</b>	<b>4.7</b>	<b>3.6</b>
<b>Mean --&gt;</b>	2.9	2.9	4.1	3.2	4.5	2.8	5.2	2.9	6.2	2.6	4.6	2.9

**Siemens**  
 Unit system: SI derived unit  
 Unit of: Electric conductance  
 Symbol: S  
 Named after: Werner von Siemens  
 In SI base units: 1 S = 1 kg<sup>-1</sup>·m<sup>-2</sup>·s<sup>3</sup>·A<sup>2</sup>

- EC dS/m = measurement of electrical conductance.
- Higher numbers indicate increasing soil salinity.
- Readings > 4 indicate highly saline situation.
- Numbers in **bold** indicate higher forage production than the average of all species

**Table CA-8. Forage quality (plot averages) at Carrington - 2013**

Variety / Species	Plot	CP	HDP	AP	NFC	ADF	NDF	CF	TDN	NEL	NEM	NEG	DDM	(Ca),%	(P),%	(K),%	MAG (Mg),%	RFV
<b>Garrison creeping foxtail</b>	1	4.1	0.59	3.8	20.8	43.5	63.8	34.8	53.0	0.54	0.49	0.24	55.0	0.48	0.14	1.38	0.13	80
	2	3.8	0.58	3.5	20.6	43.7	64.3	35.0	52.7	0.54	0.49	0.23	54.8	0.49	0.14	1.32	0.13	80
	3	4.3	0.60	4.0	21.5	42.0	62.9	33.6	54.7	0.56	0.52	0.26	56.2	0.50	0.14	1.26	0.15	83
	4	4.4	0.60	4.1	18.2	45.1	66.1	36.0	51.2	0.52	0.46	0.21	53.8	0.43	0.17	1.69	0.15	76
	5	4.2	0.57	4.0	19.7	43.9	64.8	35.1	52.5	0.53	0.48	0.23	54.7	0.48	0.14	1.43	0.14	79
<b>Averages--&gt;</b>		4.2	0.59	3.9	20.2	43.6	64.4	34.9	52.8	0.53	0.49	0.23	54.9	0.47	0.14	1.42	0.14	80
<b>Lincoln smooth bromegrass</b>	1	4.3	0.54	4.1	21.5	42.3	62.9	33.8	54.3	0.55	0.51	0.26	56.0	0.52	0.07	0.88	0.15	83
	2	4.7	0.46	4.7	22.4	40.9	61.6	32.7	55.9	0.57	0.54	0.28	57.0	0.55	0.10	1.07	0.19	86
	3	4.2	0.44	4.2	22.7	41.3	61.7	33.1	55.4	0.56	0.53	0.28	56.7	0.55	0.08	0.94	0.18	85
	4	4.6	0.46	4.6	22.5	41.1	61.5	32.9	55.6	0.57	0.53	0.28	56.8	0.53	0.10	1.10	0.18	87
	5	5.7	0.52	5.7	20.1	42.3	62.8	33.8	54.4	0.56	0.51	0.26	56.0	0.54	0.12	1.18	0.20	83
<b>Averages--&gt;</b>		4.7	0.48	4.7	21.8	41.6	62.1	33.3	55.1	0.56	0.52	0.27	56.5	0.54	0.09	1.03	0.18	85
<b>Fleet meadow bromegrass</b>	1	5.9	0.59	5.9	18.3	44.5	64.4	35.6	51.8	0.52	0.47	0.22	54.2	0.65	0.15	1.51	0.21	79
	2	5.2	0.52	5.1	19.3	42.7	64.3	34.1	53.9	0.55	0.50	0.25	55.7	0.58	0.12	1.25	0.20	81
	3	4.5	0.59	4.3	15.7	44.7	68.5	35.8	51.6	0.52	0.46	0.21	54.1	0.48	0.09	1.02	0.16	73
	4	5.9	0.57	5.9	18.4	43.6	64.5	34.9	52.9	0.53	0.49	0.23	55.0	0.67	0.15	1.48	0.24	79
	5	7.0	0.58	7.0	20.2	42.4	61.5	33.9	54.2	0.55	0.51	0.25	55.9	0.79	0.18	1.63	0.27	85
<b>Averages--&gt;</b>		5.7	0.57	5.6	18.4	43.6	64.6	34.9	52.9	0.53	0.49	0.23	55.0	0.63	0.14	1.38	0.21	79
<b>Mandan Canada wildrye</b>	1	6.0	0.53	6.0	15.1	41.7	67.7	33.4	55.0	0.56	0.52	0.27	56.4	0.49	0.10	0.87	0.19	78
	2	5.5	0.50	5.5	17.0	41.5	66.2	33.2	55.3	0.56	0.53	0.27	56.6	0.47	0.10	0.81	0.18	80
	3	5.3	0.52	5.3	18.0	40.4	65.3	32.3	56.5	0.58	0.55	0.29	57.5	0.51	0.10	0.87	0.17	82
	4	5.6	0.53	5.5	16.9	41.4	66.2	33.1	55.3	0.56	0.53	0.27	56.6	0.50	0.11	0.86	0.19	80
	5	5.8	0.51	5.8	17.9	40.8	64.9	32.6	56.0	0.57	0.54	0.28	57.1	0.48	0.11	0.81	0.17	82
<b>Averages--&gt;</b>		5.6	0.52	5.6	17.0	41.2	66.1	32.9	55.6	0.56	0.53	0.27	56.8	0.49	0.10	0.84	0.18	80

Variety / Species	Plot	CP	HDP	AP	NFC	ADF	NDF	CF	TDN	NEL	NEM	NEG	DDM	(Ca),%	(P),%	(K),%	MAG (Mg),%	RFV
<b>Shoshone manystem wildrye</b>	1	6.9	0.79	6.7	12.9	43.1	68.9	34.5	53.4	0.54	0.50	0.24	55.3	0.48	0.19	1.72	0.16	75
	2	6.4	0.78	6.2	12.8	42.6	67.8	34.9	52.9	0.54	0.49	0.24	55.0	0.44	0.19	1.73	0.14	74
	3	7.1	0.76	7.0	11.6	43.5	70.0	34.8	53.0	0.54	0.49	0.24	55.0	0.44	0.18	1.68	0.15	73
	4	8.0	0.79	8.0	11.0	43.9	69.7	35.1	52.5	24.45	0.51	0.35	28.1	0.49	0.20	1.83	0.17	73
	5	7.2	0.78	7.1	12.3	43.4	69.2	34.7	53.0	0.54	0.49	0.24	55.1	0.47	0.21	1.92	0.17	74
<b>Averages--&gt;</b>		7.1	0.78	7.0	12.1	43.3	69.1	34.8	53.0	5.32	0.49	0.26	49.7	0.46	0.19	1.77	0.16	74
<b>Alkar tall wheatgrass</b>	1	6.1	0.52	6.1	9.5	46.8	73.1	37.4	49.2	0.49	0.43	0.18	52.4	0.30	0.16	1.19	0.16	67
	2	5.0	0.51	5.0	10.9	46.7	72.7	37.3	49.3	0.50	0.43	0.18	52.5	0.30	0.15	1.13	0.17	67
	3	4.9	0.57	4.8	10.1	48.2	73.6	38.5	47.6	0.48	0.41	0.16	51.4	0.28	0.15	1.18	0.16	65
	4	6.4	0.48	6.4	10.6	45.9	71.7	36.7	50.3	0.51	0.45	0.20	53.2	0.34	0.18	1.43	0.18	69
	5	6.4	0.47	6.4	10.1	45.7	72.2	36.6	50.4	0.51	0.45	0.20	53.3	0.35	0.18	1.41	0.20	69
<b>Averages--&gt;</b>		5.8	0.51	5.7	10.2	46.6	72.7	37.3	49.4	0.49	0.43	0.18	52.6	0.31	0.16	1.26	0.17	67
<b>Revenue slender wheatgrass</b>	1	5.7	0.52	5.7	14.1	41.0	68.9	32.8	55.8	0.57	0.54	0.28	57.0	0.43	0.10	0.70	0.16	77
	2	6.5	0.63	6.4	13.5	40.6	68.7	32.5	56.2	0.58	0.54	0.28	57.2	0.46	0.11	0.83	0.16	78
	3	5.3	0.65	5.1	14.9	41.7	68.5	33.4	55.0	0.56	0.52	0.26	56.4	0.45	0.10	0.75	0.15	77
	4	5.6	0.68	5.4	11.6	43.7	71.5	35.0	52.7	0.53	0.49	0.23	54.8	0.42	0.12	0.92	0.14	71
	5	6.0	0.67	5.9	11.9	43.5	70.8	34.8	53.0	0.54	0.49	0.24	55.0	0.39	0.12	0.83	0.14	72
<b>Averages--&gt;</b>		5.8	0.63	5.7	13.2	42.1	69.7	33.7	54.5	0.55	0.51	0.26	56.1	0.43	0.11	0.81	0.15	75
<b>Rodan western wheatgrass</b>	1	5.3	0.41	5.3	17.9	39.7	65.5	31.8	57.2	0.58	0.56	0.30	57.9	0.51	0.09	0.63	0.18	82
	2	5.3	0.43	5.3	16.4	40.6	67.0	32.5	56.3	0.58	0.54	0.29	57.3	0.41	0.10	0.74	0.17	80
	3	4.2	0.41	4.1	17.4	41.1	67.1	32.9	55.7	0.56	0.52	0.27	56.9	0.44	0.08	0.59	0.17	79
	4	5.5	0.42	5.5	17.0	40.1	66.1	32.1	56.9	0.58	0.55	0.29	57.7	0.48	0.11	0.69	0.18	81
	5	5.5	0.45	5.5	16.5	40.6	63.8	50.1	55.4	0.55	0.52	0.27	56.7	0.46	0.11	0.82	0.18	79
<b>Averages--&gt;</b>		5.1	0.42	5.1	17.1	40.4	63.9	35.9	56.3	0.57	0.54	0.28	57.3	0.46	0.09	0.69	0.17	80

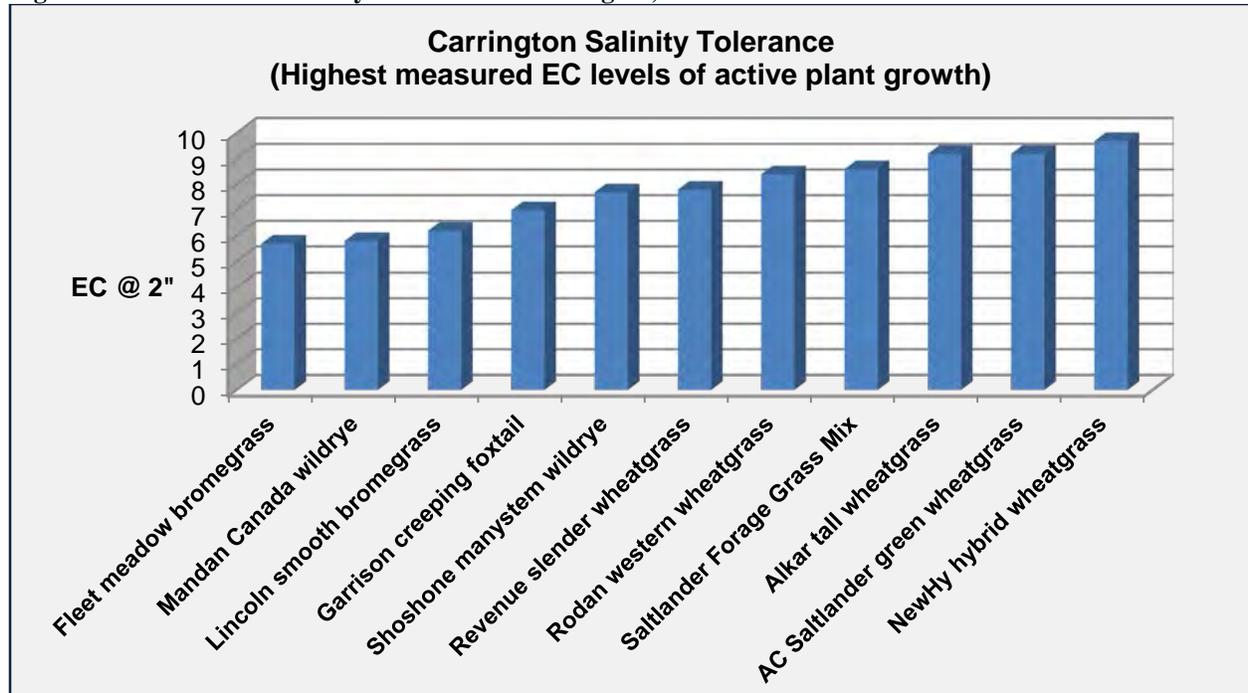
Variety / Species	Plot	CP	HDP	AP	NFC	ADF	NDF	CF	TDN	NEL	NEM	NEG	DDM	(Ca),%	(P),%	(K),%	MAG (Mg),%	RFV
<b>NewHy Hybrid Wheatgrass</b>	1	4.8	0.48	4.7	22.8	39.8	61.1	31.8	57.2	0.58	0.55	0.30	57.9	0.49	0.12	0.99	0.15	88
	2	4.5	0.54	4.3	22.4	40.4	61.8	32.3	56.5	0.58	0.54	0.29	57.4	0.50	0.13	1.14	0.15	86
	3	4.2	0.55	4.0	21.9	40.9	62.6	32.7	56.0	0.57	0.53	0.28	57.1	0.50	0.13	1.22	0.15	85
	4	3.8	0.54	3.6	21.5	41.6	63.3	33.3	55.1	0.56	0.52	0.27	56.5	0.47	0.13	1.19	0.15	83
	5	7.0					40.5	62.8	32.4	56.4	0.57	0.54	0.29	57.4	0.51	0.18	1.45	0.21
<b>Averages--&gt;</b>		4.9	0.53	4.2	22.1	40.6	62.3	32.5	56.2	0.57	0.54	0.28	57.3	0.49	0.14	1.20	0.16	85
<b>AC Saltlander Green Wheatgrass</b>	1	6.1	0.58	6.1	21.6	38.6	61.0	30.9	58.6	0.60	0.58	0.32	58.9	0.53	0.15	1.19	0.16	90
	2	4.2	0.56	4.0	21.7	40.9	62.8	32.7	56.0	0.57	0.54	0.28	57.1	0.49	0.12	1.15	0.14	85
	3	3.7	0.55	3.4	22.4	41.0	62.6	32.8	55.8	0.57	0.53	0.28	57.0	0.49	0.10	1.12	0.12	85
	4	4.5	0.53	4.4	22.8	39.6	61.3	31.7	57.4	0.59	0.56	0.30	58.0	0.45	0.12	1.12	0.13	88
	5	6.2	0.57	6.1	18.0	41.5	64.5	33.2	55.2	0.56	0.53	0.27	56.5	0.48	0.15	1.29	0.18	82
<b>Averages--&gt;</b>		5.0	0.55	4.8	21.3	40.3	62.4	32.3	56.6	0.58	0.54	0.29	57.5	0.49	0.13	1.17	0.14	86
<b>Saltlander Forage Mix</b>	1	5.6	0.70	5.4	19.3	42.1	63.8	33.7	54.6	0.56	0.52	0.26	56.1	0.56	0.19	1.62	0.23	82
	2	4.7	0.59	4.4	22.2	40.6	61.9	32.5	56.2	0.58	0.54	0.29	57.3	0.55	0.14	1.31	0.17	86
	3	4.1	0.57	3.9	22.6	40.9	61.9	32.8	55.9	0.57	0.54	0.28	57.0	0.50	0.12	1.23	0.15	86
	4	5.8	0.56	5.8	20.5	40.3	62.5	32.3	56.6	0.58	0.54	0.29	57.5	0.48	0.16	1.41	0.17	86
	5	6.9	0.54	6.8	21.6	38.8	60.2	31.0	58.3	0.60	0.57	0.31	58.7	0.53	0.17	1.32	0.22	91
<b>Averages--&gt;</b>		5.4	0.59	5.2	21.2	40.6	62.0	32.4	56.3	0.57	0.54	0.28	57.3	0.52	0.15	1.38	0.18	86

**Table CA-9. Forage quality summary (all locations and salinity levels) at Carrington – 2013**

Variety and Species	CP	ADF	NDF	CF	TDN	RFV
Garrison creeping foxtail	4.15	43.63	64.37	34.91	52.80	<b>79.74</b>
Lincoln smooth brome	4.71	41.58	62.11	33.27	<b>55.14</b>	<b>84.82</b>
Fleet meadow brome	<b>5.70</b>	43.60	64.60	34.90	52.90	<b>79.00</b>
Mandan Canada wildrye	<b>5.64</b>	41.15	66.07	<b>32.92</b>	<b>55.63</b>	<b>80.09</b>
Shoshone manystem wildrye	<b>7.13</b>	43.29	69.12	34.79	52.97	73.76
Alkar tall wheatgrass	<b>5.77</b>	46.64	72.66	37.31	49.37	67.36
Revenue slender wheatgrass	<b>5.81</b>	42.11	69.66	33.69	<b>54.54</b>	74.98
Rodan western wheatgrass	5.15	<b>40.42</b>	<b>63.91</b>	35.86	<b>56.30</b>	<b>80.26</b>
NewHy hybrid wheatgrass	4.85	<b>40.63</b>	<b>62.33</b>	<b>32.50</b>	<b>56.23</b>	<b>85.48</b>
AC Saltlander green wheatgrass	4.95	<b>40.31</b>	<b>62.44</b>	<b>32.25</b>	<b>56.59</b>	<b>85.77</b>
Saltlander forage mix	<b>5.42</b>	<b>40.55</b>	<b>62.04</b>	<b>32.44</b>	<b>56.32</b>	<b>86.09</b>
<b>Averages-&gt;</b>	<b>5.40</b>	<b>40.93</b>	<b>64.04</b>	<b>33.14</b>	<b>53.10</b>	<b>77.23</b>

\*\* Numbers in **Bold** indicate **quality** that is better than the plot averages; CF, ADF, NDF, and CP values below the average indicate better quality

**Figure CA-2. Observed Salinity Tolerance at Carrington, North Dakota**



## ACTIVE STUDIES: TECHNICAL REPORT 2013

<b>Study Number</b>	<b>NDPMC-T-1201</b>
<b>Title</b>	<b>Rhizome Growth Comparison of AC Saltlander, NewHy, Quackgrass, and Smooth Brome</b>
<b>Objective</b>	Compare rhizome spread, seed production and overall growth of AC Saltlander and NewHy to quackgrass and smooth brome.
<b>Duration</b>	2012-2014
<b>Cooperators</b>	USDA, NRCS Bismarck Plant Materials Center
<b>Location</b>	Bismarck, ND PMC
<b>-----Soils</b>	Mandan silt loam
<b>-----MLRA</b>	53B
<b>-----Precip.</b>	<b>Ave.</b> (1981-2010): 17.8 inches <b>2013:</b> 26.75 inches

**Background information:** Palatable forage species are needed for planting on saline sites. Available species for planting these sites are limited. Recent releases, AC Saltlander and NewHy are adapted to saline conditions. Seed is available in the seed market. Both releases are quackgrass hybrids. Quackgrass is a noxious weed in many states. It is strongly rhizomatous and can become invasive. Though the literature indicates that these releases have a more bunch-type growth than quackgrass, questions have been raised about their invasiveness in the Dakota's and Minnesota. The effects that rhizome spread and seed production may have on land adjoining the area where AC Saltlander and NewHy may be planted is of concern. Data from this study will be considered when determining the inclusion or exclusion of these releases in the ND NRCS Field Office Technical Guide. In this study, the AC Saltlander and NewHy are compared with quackgrass and smooth brome. Smooth brome is also a very rhizomatous species that can become invasive.

AC Saltlander was developed by researchers in Utah and Saskatchewan. Its parental origin is Turkey. It is a natural hybrid between the Eurasian bluebunch wheatgrass complex (*Pseudoroegneria strigosa*, *P. geniculata*, *P. stiffifolia*) and quackgrass (*Elymus repens*). Its common name is green wheatgrass and the species name of the cross is *Elymus hoffmannii*. The physical characteristics of the seed are similar to quackgrass but it is genetically different from quackgrass. Plants from the original collection were selected for bunchy growth, vegetative vigor, leafiness, seed set, uniform plant color and freedom from pests. It was further selected for resistance to root zone salinity, winter hardiness, and other desirable traits. It is documented to have a limited degree of rhizomatous growth.

NewHy was developed by USDA forage breeders in Utah. It was synthetically developed by crossing quackgrass with the native North American bluebunch wheatgrass (*Pseudoroegneria spicata*). Field trials in Utah, Idaho, and Montana suggest it is suitable for sites with moderate to severe salinity which receive at least 13 inches of moisture.

### **Methods and Materials**

<b>Seed Source</b>	AC Saltlander, NewHy, Rebound smooth brome, quackgrass
<b>Propagation</b>	Seed planted to cone-tainers in the greenhouse, then seedlings planted to field bed
<b>-----Greenhouse</b>	<b>Planting Date:</b> March 2012 <b>Pots:</b> Ray Leach cone-tainers™ (2" x 7") <b>Soil:</b> Miracle Grow Potting Mix
<b>-----Field</b>	<b>Planting Date:</b> May 21, 2012 <b>Planting Method:</b> By hand with dibble bar <b>Conditions:</b> soil firm and slightly moist, black and free of growing weeds
<b>Assembly</b>	See <b>Figure RH-1</b> for plot layout
<b>-----Location</b>	Bismarck Plant Materials Center, Panel A <b>USDA Hardiness Zone (2012):</b> 4a
<b>-----Design</b>	Randomized complete block <b>Reps:</b> 4; each of the four species were planted in blocks of 10 plants for each replication.
<b>Data Collection</b>	<b>Dates:</b> 7/20/2012, 9/12/2012, 5/16/2013, 7/12/2013
<b>-----Parameters</b>	<b>2012:</b> height, width, vigor, no. of culms, rhizome spread, plant size <b>2013:</b> biomass, height, rhizome spread, stand
<b>-----Methods</b>	Measurements and Ratings. Biomass was clipped to a 4-6" stubble height using a REM forage harvester. Samples were dried to determine biomass; based on number of plants clipped.
<b>-----Data</b>	See <b>Table RH-1</b> for data for all parameters except biomass. See <b>Table RH-2</b> for biomass data for clipped forage amounts.

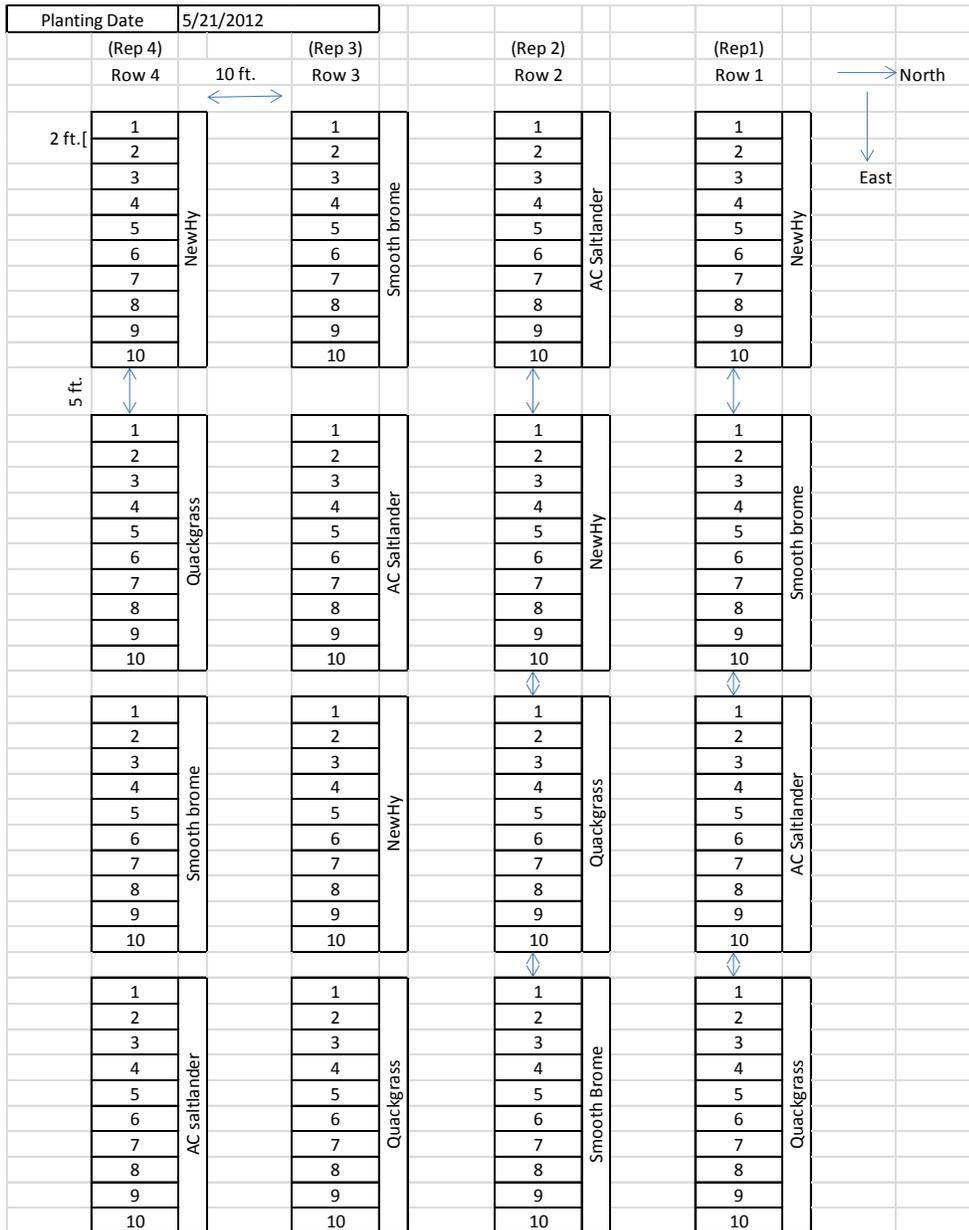
<b>Field Maintenance</b>	
-----2012	Weeding, spot sprayed glyphosate on strawberry clover and Canada thistle
-----2013	Hand weeding, spot spraying of Canada thistle

### Results and Discussion

**2012:** Plant growth was good for all species. The dry, hot conditions for 2012 probably slowed growth on all plants in the study. Only a few plants died from transplanting. As first year transplants, plants were becoming established and plant growth was not consistent. Quackgrass height, overall, was shorter compared to the other entries. Rhizome growth appeared to start later in the season. Visual observations of the plots after the September data collection showed tremendous rhizome spread for some plants. This growth will be captured with 2013 measurements. Strawberry clover was previously planted in the field used for this study. It was controlled in 2012, but may become a problem if it is not closely managed.

**2013:** Growth was measured in May and July of 2013. Plants continued to grow taller and wider as the year progressed. Height and widths averaged across all replications for a species showed quackgrass to have the greatest spread and the shortest stature when measured in July 2013. Spread for NewHy and AC Saltlander was greater than for smooth brome, but less than quackgrass.

**Figure RH-1. Plot layout of rhizome growth comparison of ACSaltlander, NewHy, quackgrass, and smooth brome**



**Table RH-1. 2012-2013 data from rhizome growth comparison of AC Saltlander, NewHy, quackgrass, and smooth brome**

**Ratings**

spread: 1=excellent, 9=poor                      size: 1=large, 9=small  
 vigor: 1=excellent, 9=poor                      stand: 1=excellent, 3=poor  
 culms: 1=many, 9=none

Species	Rep	Date	Height (in.)	Spread rating	Width (in.)	Vigor rating	Culms rating	Size rating	seedheads (no.)	new shoots (no.)	Stand rating
ACSalt	1	7/20/12		5.7				3.7	5.6	6.6	
ACSalt	1	9/12/12	14.3		29.6	4.9	7.8				
ACSalt	1	5/16/13	15.4		29.1						1.7
ACSalt	1	7/12/13	50.0		37.5						
ACSalt	2	7/20/12		4.5				3.3	3.7		
ACSalt	2	9/12/12	16.0		34.3	4.0	7.0				
ACSalt	2	5/16/13	14.9		31.8						1.7
ACSalt	2	7/12/13	53.0		57.1						
ACSalt	3	7/20/12		3.0				3.1	6.3		
ACSalt	3	9/12/12	21.0		32.3	3.1	6.5				
ACSalt	3	5/16/13	14.0		34.6						2.2
ACSalt	3	7/12/13	50.0		32.1						
ACSalt	4	7/20/12		6.1				3.2	13.1		
ACSalt	4	9/12/12	12.1		28.3	3.6	6.0				
ACSalt	4	5/16/13	15.5		35.5						1.6
ACSalt	4	7/12/13	53.0		32.7						
Brome	1	7/20/12		3.2				2.5	7.0	21.3	
Brome	1	9/12/12	22.6		29.7	4.7	5.3				
Brome	1	5/16/13	15.4		27.0						1.8
Brome	1	7/12/13	51.0		40.2						
Brome	2	7/20/12		3.4				3.9	6.2		
Brome	2	9/12/12	19.6		23.9	4.7	5.9				
Brome	2	5/16/13	15.8		23.0						1.8
Brome	2	7/12/13	53.0		30.2						
Brome	3	7/20/12		4.2				4.0	3.1		
Brome	3	9/12/12	19.7		28.7	4.4	6.6				
Brome	3	5/16/13	15.7		23.8						1.8
Brome	3	7/12/13	53.0		28.1						
Brome	4	7/20/12		5.0				3.8	5.6		
Brome	4	9/12/12	22.9		22.2	3.6	7.0				
Brome	4	5/16/13	16.6		25.0						1.5
Brome	4	7/12/13	53.0		24.1						
NewHy	1	7/20/12		4.7				2.2	13.8	4.0	
NewHy	1	9/12/12	19.1		35.0	3.7	6.3				
NewHy	1	5/16/13	13.9		32.5						2.1
NewHy	1	7/12/13	53.0		41.2						
NewHy	2	7/20/12		4.0				2.7	18.5		
NewHy	2	9/12/12	18.4		33.4	3.7	5.1				
NewHy	2	5/16/13	15.9		30.4						1.9
NewHy	2	7/12/13	50.0		38.1						

Species	Rep	Date	Height (in.)	Spread rating	Width (in.)	Vigor rating	Culms rating	Size rating	seedheads (no.)	new shoots (no.)	Stand rating
NewHy	3	7/20/12		6.0				3.4	10.3		
NewHy	3	9/12/12	19.7		28.6	3.7	5.7				
NewHy	3	5/16/13	19.3		27.0						1.7
NewHy	3	7/12/13	50.0		26.8						
NewHy	4	7/20/12		3.9				2.6	8.2		
NewHy	4	9/12/12	15.4		30.7	4.3	7.0				
NewHy	4	5/16/13	14.4		35.5						1.9
NewHy	4	7/12/13	54.0		32.9						
Quack	1	7/20/12		6.0				5.4	0.7	2.9	
Quack	1	9/12/12	7.4		27.0	6.2	8.4				
Quack	1	5/16/13	8.0		38.6						2.4
Quack	1	7/12/13	45.0		57.7						
Quack	2	7/20/12		5.4				3.9	2.3		
Quack	2	9/12/12	11.3		29.9	5.4	7.7				
Quack	2	5/16/13	10.8		44.4						1.8
Quack	2	7/12/13	48.0		52.3						
Quack	3	7/20/12		5.3				4.5	4.2		
Quack	3	9/12/12	10.6		32.3	4.7	7.2				
Quack	3	5/16/13	12.7		37.7						1.8
Quack	3	7/12/13	48.0		41.1						
Quack	4	7/20/12		7.8				4.4	6.8		
Quack	4	9/12/12	9.9		25.5	4.7	5.9				
Quack	4	5/16/13	8.4		34.5						2.1
Quack	4	7/12/13	44.0		36.6						

**Table RH-2. 2013 Biomass data for clipped forage amounts of AC Saltlander, NewHy, quackgrass, and smooth brome**

Variety	Rep	Date	Rep	No. Plants	Total Plot dry kg
ACSalt	1	7/12/2013	1	10	2.62
ACSalt	2	7/12/2013	2	10	2.96
ACSalt	3	7/12/2013	3	8	3.67
ACSalt	4	7/12/2013	4	10	3.25
Brome	1	7/12/2013	1	10	2.73
Brome	2	7/12/2013	2	10	2.98
Brome	3	7/12/2013	3	10	2.68
Brome	4	7/12/2013	4	10	3.20
NewHy	1	7/12/2013	1	10	2.74
NewHy	2	7/12/2013	2	9	3.10
NewHy	3	7/12/2013	3	10	3.40
NewHy	4	7/12/2013	4	10	3.51
Quack	1	7/12/2013	1	10	2.75
Quack	2	7/12/2013	2	10	3.44
Quack	3	7/12/2013	3	9	3.62
Quack	4	7/12/2013	4	6	3.50

**ACTIVE STUDIES: TECHNICAL REPORT 2013**

<b>Study Number</b>	<b>NDPMC-T-1202</b>
<b>Title</b>	<b>Cupplant Evaluation, northern origin (<i>Silphium perfoliatum</i>)</b>
<b>Objective</b>	Evaluate performance of northern origin cupplant and evaluate species attributes for bioengineering, riparian, pollinators, and others. Release and technology is the goal.
<b>Duration</b>	2012-2020
<b>Cooperators</b>	USDA, NRCS Bismarck Plant Materials Center
<b>Location</b>	Bismarck, ND PMC
<b>-----Soils</b>	Mandan silt loam
<b>-----MLRA</b>	53B
<b>-----Precip.</b>	<b>Ave</b> (1981-2010): 17.8 inches <b>(2013):</b> 26.75

**Background information:** Cupplant is a tall, warm-season species native to the tall grass prairie. It has a taproot and underground rhizomes. Its cup forming leaves are important for pollinator species. It prefers moist sites. Native northern sources of the species are not readily found. The PMC is evaluating a northern origin source (or sources if more are found).

**Methods and Materials**

The planting in 2012 consisted of one seed origin.

<b>Seed Source</b>	<b>Accession:</b> 9094351
<b>-----Coll. Date</b>	September 19, 2011
<b>-----Collector</b>	Jeff Printz
<b>-----Location</b>	T135N R56W sec 30 Ransom County, ND approx. 4 miles NW of Lisbon off of Valley Road, landowner: Andy Hoenhouse <b>USDA Hardiness Zone</b> (2012): 4a
<b>Propagation</b>	Seed planted to cone-tainers™ in the greenhouse, then seedlings planted to field bed
<b>-----Greenhouse</b>	<b>Planting Date:</b> February 2012 <b>Pots:</b> Ray Leach cone-tainers™(2 “x 7”) <b>Soil:</b> Miracle Grow Potting Mix
<b>-----Field</b>	<b>Planting Method:</b> Holes dug with shovel and garden trowel <b>Planting Conditions:</b> Soil firm and slightly moist, black and free of growing weeds, freshly tilled <b>Planting Date:</b> June 11, 2012
<b>Assembly</b>	<b>NO MAP</b>
<b>-----Location</b>	Bismarck Plant Materials Center, Panel D10 (old deer fence) <b>USDA Hardiness Zone</b> (2012): 4a
<b>-----Design</b>	<b>No. of Rows:</b> 5 <b>Row spacing:</b> 7-10’ <b>Plant Spacing:</b> 2’-3’
<b>Data Collection</b>	None in 2012
<b>-----Parameters</b>	2012: none
<b>-----Data</b>	2012: none 2013: seed production
<b>Field Maintenance</b>	Weed control, residue removal
<b>-----2012</b>	Hand weeding, tillage between rows, no residue removal, no herbicide, no irrigation
<b>Seed Harvest</b>	Combined with Wintersteiger combine on September 26, 2013
<b>-----2013</b>	108 pounds dirty seed; Cleaned amount (lbs): 45 bulk, 25 PLS

**Results and Discussion**

**2012:** Plants were vigorous and appeared healthy throughout the growing season, even though the summer was hot and dry. Plants had only basal, rosette type growth this first year of growth.

**2013:** Weeds were suppressed by oat planting. Plants grew to approximately 6 feet. Seed heads were produced on most, if not all of the plants. There was no sign of predation from insects or disease on the seed heads. The plants showed drought stress on the leaves, but it was slight. Plants were vigorous overall.

**ACTIVE STUDIES: TECHNICAL REPORT 2013**

<b>Study Number</b>	<b>NDPMC-T-1203</b>
<b>Title</b>	<b>Effects of Mixed Species Cover Crops on Soil Health</b>
<b>Objective</b>	Evaluate the effects of different cover crop species mixes, and seeding rates on soil health
<b>Duration</b>	2012-2014+ (extension of study is probable, depending on outcomes)
<b>Cooperators</b>	Plant Materials Program, NRCS National Soil Health Team, ,USDA-NRCS National Soil Survey Center (Lincoln, NE, Kellog Soil Survey Lab),USDA-ARS (Temple, TX)
<b>Location</b>	Field D-7 Bismarck, ND Plant Materials Center
<b>---Soils</b>	Mandan silt loam, <b>See Figure CC-1 for Soils Mapping Units</b>
<b>---MLRA</b>	53B
<b>---Ave. Precip.</b>	<b>Overall (1981-2010) = 17.8 inches; 2012 overall = 14.9 inches 2012 cover crop planting to termination=2.08 inches 2013 overall: 26.75</b>
<b>---Lat./Long.</b>	Latitude=46°46', Longitude=100° 45W, Elev.=1647
<b>Other Locations w/ Similar Study</b>	Plant Materials Centers in CA, FL, MD, MO,WA

**Background information:** This is a National Plant Materials project evaluating the effect of different cover crop species and seeding rates on soil health. There are six Plant Materials Centers participating in this study. The commodity crop to be planted by ND and WA PMC is barley. Corn will be planted by all other PMC's. Protocols for designing the experiment and data collection were compiled by Regional Specialists of the Plant Materials Program. This information is filed in the Cover Crop study binder.

**Materials and Method**

<b>Experimental Design</b>	Randomized complete block; Replications: 4
<b>---Plot size</b>	Each plot: 30' x 50' Total plots: 40 <b>See Figure CC-2 for Plot Map</b>
<b>Cover Crop</b>	
<b>---Mixes</b>	<b>2 species:</b> triticale, red clover <b>4 species:</b> triticale, red clover, hairy vetch, radish <b>6 species:</b> triticale, red clover, hairy vetch, radish, oats, rapeseed <b>No species:</b> no cover crop (control).
<b>---Seed source</b>	Pulse USA, Bismarck ND
<b>---Seeding rates</b>	20 seeds/ft <sup>2</sup> ; 40 seeds/ft <sup>2</sup> ; 60 seeds/ft <sup>2</sup> <b>See Table CC-1 for lb/ac seeded</b>
<b>---Seeding method</b>	<b>2012:</b> No-till plot drill (Great Plains) borrowed from ARS, used boxes for seeding in; <b>2013:</b> used cone for seeding mixes
<b>---Seeding date</b>	August 2, 2012; August 20, 2013
<b>---Termination</b>	September 21, 2012; October 30, 2013
<b>---Termination method</b>	Natural freezing
<b>Commodity Crop</b>	
<b>---Species</b>	Barley: Rawson 2 row
<b>---Seed source</b>	2012: none; 2013: Pulse USA, Bismarck ND (Rawson 2-row barley)
<b>---Seeding rate</b>	<b>2013:</b> 90 lb/ac
<b>---Seeding Method</b>	No-till plot drill (Great Plains) , used cone for seeding (2013)
<b>---Seeding date</b>	5/8/2013
<b>---Termination</b>	8/6/2013
<b>---Termination Method</b>	Swathed and baled off forage and seed, no seed harvest other than sampling within plot

**Data Collection: Unless otherwise indicated Cover Crop Mixes on data tables are as listed below:**

220 =2 species, 20 seeds/ft <sup>2</sup>	420 =4 species, 20 seeds/ft <sup>2</sup>	620 =6 species, 20 seeds/ft <sup>2</sup>
240 =2 species, 40 seeds/ft <sup>2</sup>	440 =4 species, 40 seeds/ft <sup>2</sup>	640 =6 species, 40 seeds/ft <sup>2</sup>
260 =2 species, 60 seeds/ft <sup>2</sup>	460 =4 species, 60 seeds/ft <sup>2</sup>	660 =6 species, 60 seeds/ft <sup>2</sup>
1000=check		

Methods for data collection are found in *Sampling Methods for Plant Materials Program Soil Health Study in the Cover Crop Study Binder*.

<b>Sample area</b>	A portion of the plot was sampled.
<b>Data Parameters</b>	Soils, Vegetative for cover crop (the portion of the plot sampled was approx. 17'X30'), Yield for Barley.

All plots were divided into three sections for the three years of data collection. This is indicated on the plot map. A different section will be sampled each of the three years. All data, unless indicated otherwise, will be taken from the designated section.

---**2012**: Dates of sampling generally indicate at cover crop planting, at 30 days from planting, and/or cover crop termination (47 days).

---**2013**: Dates of sampling generally indicate at commodity crop planting (barley), at cover crop planting, and cover crop termination.

Soils Parameter	Date of Sample	Method	Depth	Samples	Data Table
---classification	7/30/2012	Order 1 Soil Survey, descriptions made, sent to soil survey lab to cross check soil particle size			<b>Figure CC-1</b>
---bulk density	7/30/2012 8/20/2013	3" ring (soil quality test kit)	0-3 inches	5 samples/plot	<b>Table CC-2</b>
---temperature	7/30/2012 9/25/2012 5/13/2013 8/20/2013 10/31/2013	soil thermometer	0-3 inches	5samples/plot	<b>Table CC-3</b>
---moisture	7/30/2012 9/25/2012 5/13/2013 8/20/2013 10/31/2013	Hydrosense moisture meter	0-3 inches	5 samples/plot	<b>Table CC-3</b>
---resistance	7/30/2012 8/20/2013	Penetrometer	6 inches	5 samples/plot	<b>Table CC-3</b>
---biological	7/30/2012 9/25/2012 5/13/2013 8/20/2013 10/31/2013	Hand trowel, samples dried at Mandan ARS, sent to Dr. Haney (TX) for analysis , kept in cold and dry storage prior to sending	0-6 inches	2/3 quart/plot	<b>Table CC-4</b>
---soil indicators	8/30/2012 8/20/2013	Hand trowel samples dried at Mandan ARS, sent to Larry Arnold, Lincoln, NE for analysis	<b>2012</b> : 0-2 and 2-4 inches <b>2013</b> : 0-2 and 2-6 inches	2/3 quart/plot for each depth	Test results are pending

---**Soil Notes**: Personnel from soils staffs within ND NRCS were leaders in collecting the soils data. Personnel from NRCS Soils staffs included: Susan Liebig, Perry Sullivan, Hal Weiser, Kyle Thomson and Beth Burdolski. PMC staff assisted the soils staff. Along with listed measured soil parameters, some infiltration rates were also

measured in a few random plots. A soil survey pit was also dug in the late fall 2012 and samples taken down to 100 cm. These samples will get a complete soil characterization by the Soil Survey Laboratory in Lincoln, NE. The pit was dug in the vicinity where the HOB0 weather station was placed in early 2013. It should also be noted that samples for soil indicator measurements were originally taken at 0-6". These were not sent in for analysis, but were archived to use as baseline data, if needed.

<b>Plant Parameter Cover Crop</b>	<b>Date of Sample</b>	<b>Method</b>	<b>Number of Samples</b>	<b>Data Table</b>
---canopy cover	8/31/2012 9/25/2012 2013-none	Line transect-entire plot (30'X 50' plot size), recorded type of cover every 1 foot of diagonal transect Canopy cover was not measured in 2013 as almost all of the cover was volunteer barley.	50 points/plot	<b>Table CC-5</b>
---plant height	8/31/2012 9/25/2012 2013-none	5 random plant areas (17'X 30' portion of plot)	5 heights/plot	<b>Table CC-5</b>
---yield	9/25/2012 10/31/2013	Clipped 50cm x 100cm frame within each plot, 1/4" stubble height, separated components, dried samples at 55° C, weighed parts separately, combined all parts except radish bottom.	1 frame/plot	<b>Table CC-6</b>
---%N	9/25/2012 10/31/2013	Combined dry sample of all parts but radish bottom, hammer milled prior to sending for analysis by Dairy One Lab, Ithaca, NY (sent to NPMC to handle).	1 sample/plot (2 if radish present)	<b>Table CC-6</b>
---quality	9/25/2012 10/31/2013	Clipped random plots from entire planting and bulked within each species. Oven dried at 50° C. Sent one sample of each specie to Stearns DHIA (MN) for separate species analysis.	1 sample/species	<b>Table CC-6</b>
<b>Plant Parameter Commodity Crop Barley</b>				
---yield	8/6/2013	17-foot of one drill row was hand clipped and seed heads thrashed with head thrasher at Mandan ARS. Seed was dried down in oven. Moisture meter used at ARS.	1 sample/plot	<b>Table CC-19</b>

**---Plant Notes:** Sample drying was done in batches. Radish roots were difficult to dry, so were cut in smaller pieces. All vegetation was left standing on the plots over the winter. Height of plots was taken in inches and converted to cm. The initial hard frost was considered cover crop termination. Plants continued to grow after the initial hard frost. The ND NRCS State agronomist Ted Alme and Dwight Tober (retired PMS) assisted in clipping forage production in 2012. Dwight Tober also assisted in canopy cover measurements.

#### **Results and Discussion:**

**2012:** Cover crop growth was good even though planting date was late in the season and precipitation was 20% below normal for the growing season. Hard frosts came late in the fall, which may have allowed for extended growth. The legume component growth was not abundant, as is shown in the yield data. This may be due to the short window of time it had to grow before a frost. Baseline soils data indicated soils in all plots were high in N. This may be due to previous history of composting on the field. Growth of the cover crop in Replication 2 and Replication 4 was stunted as a result of a tree row (green ash) to the east of the field.

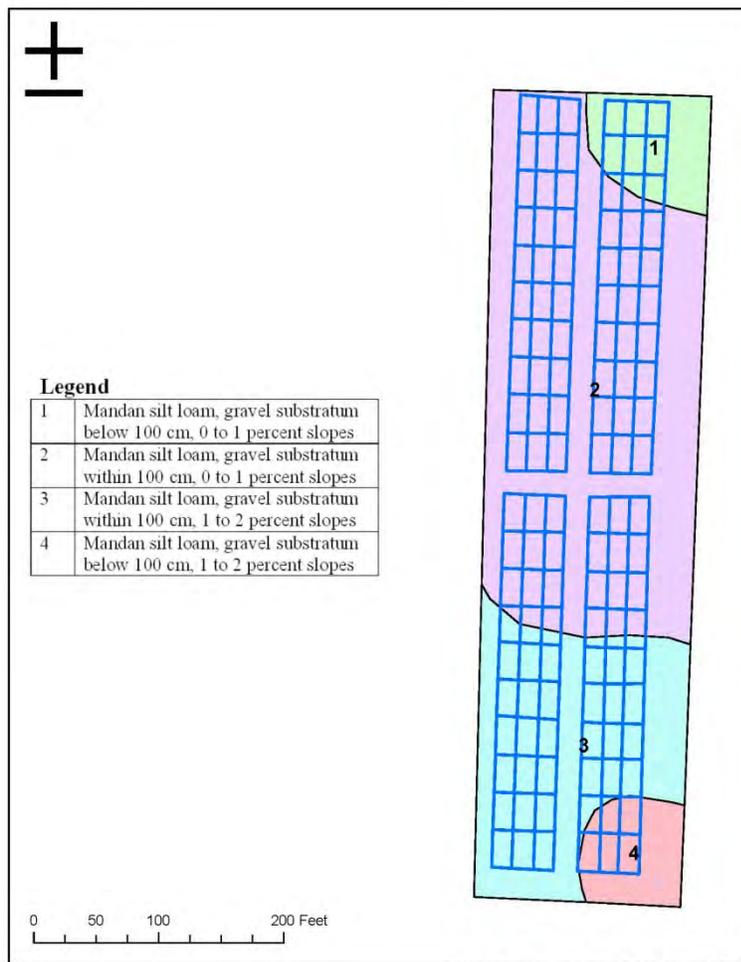
#### **2012: Summary of the Cover Crop Measurements (Joel Douglas, Regional Plant Materials Specialist)**

Early results from the cover crop measurements at Bismarck found that increasing the seeding rate of 2, 4 and 6

cover crop species/mix from 20, 40 and 60 seed/ft<sup>2</sup>, respectively, increased dry matter yield, N content, N accumulation, and plant height but the increase was not significant. Conversely, increasing the seeding rate increased early canopy cover of cover crop mixes 30 days after planting but the increase in coverage after 60 days was not significant except in the triticale and red clover treatment where % canopy cover provided by the 20 seed/ft<sup>2</sup> was 74% compared to > 90% provided by 40 and 60 seed/ft<sup>2</sup>. Oil seed radish root production and N content was not significantly influenced by seeding rate. Triticale and mixes containing oil seed radish contributed to the greatest percentage of the total dry matter yield while the least amount was provided by the legumes. Increasing the seeding rate suppressed weed growth in all seed mixes. Statistical analysis (by Joel Douglas, Regional Plant Materials Specialist) can be found in **CC-Tables 7 through 18**.

**2013:** The barley commodity crop yields were good (see **Table CC-19**). Nitrogen levels were high in 2013 and were slightly reduced after the barley crop. The cover crop was planted almost a month later than in 2012. Barley seed shattered before harvest. Though the cover crops appeared to germinate, they were overtaken by volunteer barley. Most of the forage yield in 2013 was barley.

**Figure CC-1. Cover crop study soil survey (soils mapping unit descriptions follow)**



## Soils mapping units

### Map unit 1 - Mandan silt loam, gravelly substratum below 100 cm, 0 to 1 percent slopes

Taxonomic Class: Coarse-silty, mixed, superactive, calcareous, frigid Pachic Haplustolls

The Mandan series consists of very deep, well drained soils on terraces in alluvial plains. Permeability is moderately high in the surface layer and moderately low to moderately high in the substratum. These soils formed in loess over gravel.

Landform: Terrace  
Landscape: Alluvial Plain  
Parent Material: Loess over Gravel  
Slope Range: 0 to 1%  
Depth to Gravel: > 100 cm  
Salt or Sodium Affected: Not Affected  
Drainage Class: Well  
Water Table: > 6 feet  
Ponding: None

#### Typical Profile

Ap ---0 to 28 cm; silt loam  
Bw ---28 to 57 cm; silt loam  
Bk ---57 to 86 cm; silt loam  
Bck ---86 to 110 cm; very fine sandy loam  
2C --- 110 to 120 cm; very gravelly sand

#### Typical Range

Mollic, Ap: 46-65 cm  
Depth to Carbonates: 24-30 cm  
Depth to Gravel: 102-132 cm

**Major uses:** Cropland

### Map unit 2 - Mandan silt loam, gravelly substratum within 100 cm, 0 to 1 percent slopes

Taxonomic Class: Coarse-silty, mixed, superactive, calcareous, frigid Pachic Haplustolls

The Mandan series consists of very deep, well drained soils on terraces in alluvial plains. Permeability is moderately high in the surface layer and moderately low to moderately high in the substratum. These soils formed in loess over gravel.

Landform: Terrace  
Landscape: Alluvial Plain  
Parent Material: Loess over Gravel  
Slope Range: 0 to 1%  
Depth to Gravel: 85-100 cm  
Salt or Sodium Affected: Not Affected  
Drainage Class: Well  
Water Table: > 6 feet  
Ponding: None

#### Typical Profile

Ap ---0 to 25 cm; silt loam  
Bw ---25 to 59 cm; silt loam  
Bk ---59 to 91 cm; very fine sandy loam  
2C ---91-120 cm; very gravelly sand

#### Typical Range

Mollic, Ap: 25-59 cm  
Depth to Carbonates: 25-91 cm  
Depth to Gravel: 91-120 cm

**Major uses:** Cropland

**Map unit 3 - Mandan silt loam, gravelly substratum within 100 cm, 1 to 2 percent slopes**

Taxonomic Class: Coarse-silty, mixed, superactive, calcareous, frigid Pachic Haplustolls

The Mandan series consists of very deep, well drained soils on terraces in alluvial plains. Permeability is moderately high in the surface layer and moderately low to moderately high in the substratum. These soils formed in loess over gravel.

Landform: Terrace  
Landscape: Alluvial Plain  
Parent Material: Loess over Gravel  
Slope Range: 1 to 2%  
Depth to Gravel: 85 cm  
Salt or Sodium Affected: Not Affected  
Drainage Class: Well  
Water Table: > 6 feet  
Ponding: None

**Typical Profile**

Ap ---0 to 33 cm; silt loam  
Bw ---33 to 63 cm; silt loam  
Bk ---63 to 85 cm; silt loam  
2C ---85-120 cm; very gravelly sand

**Typical Range**

Mollic, Ap: 53-63 cm  
Depth to Carbonates: 20-33 cm  
Depth to Gravel: 85-87 cm

**Major uses:** Cropland

**Map unit 4 - Mandan silt loam, gravelly substratum below 100 cm, 1 to 2 percent slopes**

Taxonomic Class: Coarse-silty, mixed, superactive, calcareous, frigid Pachic Haplustolls

The Mandan series consists of very deep, well drained soils on terraces in alluvial plains. Permeability is moderately high in the surface layer and moderately low to moderately high in the substratum. These soils formed in loess over gravel.

Landform: Terrace  
Landscape: Alluvial Plain  
Parent Material: Loess over Gravel  
Slope Range: 1 to 2%  
Depth to Gravel: 122cm +  
Salt or Sodium Affected: Not Affected  
Drainage Class: Well  
Water Table: > 6 feet  
Ponding: None

**Typical Profile**

Ap ---0 to 24 cm; silt loam  
Bw ---24 to 62 cm; silt loam  
Bk ---62 to 122 cm; silt loam  
2C ---122cm; very gravelly loamy sand

**Typical Range**

Mollic, Ap: 9-15"  
Depth to Carbonates: 24-62 cm  
Depth to Gravel: 122 cm

**Major uses:** Cropland

Figure CC-2. Plot map

<b>A</b>	<b>101</b>	<b>01</b>
YR3	YR2	YR1
<b>B</b>	<b>102</b>	<b>02</b>
YR2	YR1	YR3
<b>C</b>	<b>103</b>	<b>03</b>
YR1	YR3	YR2
<b>D</b>	<b>104</b>	<b>04</b>
YR1	YR2	YR3
<b>E</b>	<b>105</b>	<b>05</b>
YR1	YR3	YR2
<b>F</b>	<b>106</b>	<b>06</b>
YR1	YR2	YR3
<b>G</b>	<b>107</b>	<b>07</b>
YR2	YR3	YR1
<b>H</b>	<b>108</b>	<b>08</b>
YR1	YR3	YR2
<b>I</b>	<b>109</b>	<b>09</b>
YR2	YR3	YR1
<b>J</b>	<b>110</b>	<b>10</b>
YR3	YR1	YR2

<b>F</b>	<b>201</b>	<b>11</b>
YR1	YR2	YR3
<b>G</b>	<b>202</b>	<b>12</b>
YR1	YR2	YR3
<b>C</b>	<b>203</b>	<b>13</b>
YR3	YR1	YR2
<b>D</b>	<b>204</b>	<b>14</b>
YR3	YR2	YR1
<b>A</b>	<b>205</b>	<b>15</b>
YR2	YR3	YR1
<b>I</b>	<b>206</b>	<b>16</b>
YR3	YR1	YR2
<b>J</b>	<b>207</b>	<b>17</b>
YR1	YR2	YR3
<b>H</b>	<b>208</b>	<b>18</b>
YR3	YR2	YR1
<b>E</b>	<b>209</b>	<b>19</b>
YR2	YR1	YR3
<b>B</b>	<b>210</b>	<b>20</b>
YR2	YR3	YR1

<b>A</b>	Triticale, Red clover/20 seed ft <sup>2</sup>
<b>B</b>	Triticale, Red clover/40 seed ft <sup>2</sup>
<b>C</b>	Triticale, Red clover/60 seed ft <sup>2</sup>
<b>D</b>	Triticale, Red clover, Hairy Vetch, Radish/20 seed ft <sup>2</sup>
<b>E</b>	Triticale, Red clover, Hairy Vetch, Radish/40 seed ft <sup>2</sup>
<b>F</b>	Triticale, Red clover, Hairy Vetch, Radish/60 seed ft <sup>2</sup>
<b>G</b>	Triticale, Red clover, Hairy Vetch, Radish, Oats, Rapeseed/20 seed ft <sup>2</sup>
<b>H</b>	Triticale, Red clover, Hairy Vetch, Radish, Oats, Rapeseed/40 seed ft <sup>2</sup>
<b>I</b>	Triticale, Red clover, Hairy Vetch, Radish, Oats, Rapeseed/60 seed ft <sup>2</sup>
<b>J</b>	Control – No Cover Crop

<b>C</b>	<b>301</b>	<b>21</b>
YR2	YR1	YR3
<b>G</b>	<b>302</b>	<b>22</b>
YR1	YR2	YR3
<b>I</b>	<b>303</b>	<b>23</b>
YR3	YR2	YR1
<b>B</b>	<b>304</b>	<b>24</b>
YR1	YR2	YR3
<b>J</b>	<b>305</b>	<b>25</b>
YR3	YR1	YR2
<b>F</b>	<b>306</b>	<b>26</b>
YR2	YR3	YR1
<b>A</b>	<b>307</b>	<b>27</b>
YR3	YR2	YR1
<b>D</b>	<b>308</b>	<b>28</b>
YR3	YR1	YR2
<b>H</b>	<b>309</b>	<b>29</b>
YR1	YR2	YR3
<b>E</b>	<b>310</b>	<b>30</b>
YR1	YR2	YR3

<b>F</b>	<b>401</b>	<b>31</b>
YR2	YR3	YR1
<b>C</b>	<b>402</b>	<b>32</b>
YR3	YR1	YR2
<b>H</b>	<b>403</b>	<b>33</b>
YR1	YR2	YR3
<b>D</b>	<b>404</b>	<b>34</b>
YR3	YR2	YR1
<b>A</b>	<b>405</b>	<b>35</b>
YR1	YR2	YR3
<b>J</b>	<b>406</b>	<b>36</b>
YR2	YR1	YR3
<b>E</b>	<b>407</b>	<b>37</b>
YR1	YR2	YR3
<b>I</b>	<b>408</b>	<b>38</b>
YR2	YR3	YR1
<b>B</b>	<b>409</b>	<b>39</b>
YR1	YR2	YR3
<b>G</b>	<b>410</b>	<b>40</b>
YR3	YR1	YR2

Table CC-1. Seeding rates for cover crop species

Mixes	Species	Seeds/lb	Seeding Rate per Plot in seeds/ft2	% of the Mix	PLS Lbs. per Acre
<b>2 Species Mix</b>	triticale	12000	20	50	36.3
	red clover	260000		50	1.68
	triticale	12000	40	50	72.60
	red clover	260000		50	3.35
	triticale	12000	60	50	108.90
	red clover	260000		50	5.03
<b>4 Species Mix</b>	triticale	12000	20	45	32.67
	red clover	260000		22.5	0.75
	hairy vetch	21000		22.5	9.33
	radish	45000		10	1.94
	triticale	12000	40	45	65.34
	red clover	260000		22.5	1.51
	hairy vetch	21000		22.5	18.67
	radish	45000		10	3.87
	triticale	12000	60	45	98.01
	red clover	260000		22.5	2.26
	hairy vetch	21000		22.5	28.00
	radish	45000		10	5.81
<b>6 Species Mix</b>	triticale	12000	20	22.5	16.34
	red clover	260000		22.5	0.75
	hairy vetch	21000		22.5	9.33
	radish	45000		5	0.97
	oats	14000		22.5	14.00
	Rape	156960		5	0.28
	triticale	12000	40	22.5	32.67
	red clover	260000		22.5	1.51
	hairy vetch	21000		22.5	18.67
	radish	45000		5	1.94
	oats	14000		22.5	28.00
	Rape	156960		5	0.56
	triticale	12000	60	22.5	49.01
	red clover	260000		22.5	2.26
	hairy vetch	21000		22.5	28.00
	radish	45000		5	2.90
	oats	14000		22.5	42.00
	Rape	156960		5	0.83

**Table CC-2. Bulk density (core method)**

Date	Mix	Plot	Depth	Bulk Density (g/cm <sup>3</sup> )
7/30/2012	220	101	0-3"	1.30
8/21/2013	220	101	0-2"	1.19
8/21/2013	220	101	2-4"	1.28
7/30/2012	220	205	0-3"	1.22
8/21/2013	220	205	0-2"	1.26
8/21/2013	220	205	2-4"	1.20
7/30/2012	220	307	0-3"	1.04
8/21/2013	220	307	0-2"	1.11
8/21/2013	220	307	2-4"	1.21
7/30/2012	220	405	0-3"	1.18
8/21/2013	220	405	0-2"	1.06
8/21/2013	220	405	2-4"	1.20
7/30/2012	240	102	0-3"	1.28
8/21/2013	240	102	0-2"	1.24
8/21/2013	240	102	2-4"	1.41
7/30/2012	240	210	0-3"	1.16
8/21/2013	240	210	0-2"	1.16
8/21/2013	240	210	2-4"	1.17
7/30/2012	240	304	0-3"	1.10
8/21/2013	240	304	0-2"	1.13
8/21/2013	240	304	2-4"	1.06
7/30/2012	240	409	0-3"	1.19
8/21/2013	240	409	0-2"	1.09
8/21/2013	240	409	2-4"	1.20
7/30/2012	260	103	0-3"	1.23
8/21/2013	260	103	0-2"	1.23
8/21/2013	260	103	2-4"	1.29
7/30/2012	260	203	0-3"	1.23
8/21/2013	260	203	0-2"	1.15
8/21/2013	260	203	2-4"	1.16
7/30/2012	260	301	0-3"	0.97
8/21/2013	260	301	0-2"	1.15
8/21/2013	260	301	2-4"	1.14
7/30/2012	260	402	0-3"	1.05
8/21/2013	260	402	0-2"	0.94
8/21/2013	260	402	2-4"	1.27
7/30/2012	420	104	0-3"	1.23

Date	Mix	Plot	Depth	Bulk Density (g/cm <sup>3</sup> )
8/21/2013	420	104	0-2"	1.19
8/21/2013	420	104	2-4"	1.37
7/30/2012	420	204	0-3"	1.25
8/21/2013	420	204	0-2"	0.99
8/21/2013	420	204	2-4"	1.43
7/30/2012	420	308	0-3"	1.01
8/21/2013	420	308	0-2"	1.06
8/21/2013	420	308	2-4"	1.13
7/30/2012	420	404	0-3"	1.09
8/21/2013	420	404	0-2"	1.12
8/21/2013	420	404	2-4"	1.15
7/30/2012	440	105	0-3"	1.28
8/21/2013	440	105	0-2"	1.21
8/21/2013	440	105	2-4"	1.28
7/30/2012	440	209	0-3"	1.17
8/21/2013	440	209	0-2"	1.05
8/21/2013	440	209	2-4"	1.25
7/30/2012	440	310	0-3"	1.11
8/21/2013	440	310	0-2"	1.04
8/21/2013	440	310	2-4"	1.05
7/30/2012	440	407	0-3"	1.19
8/21/2013	440	407	0-2"	1.14
8/21/2013	440	407	2-4"	1.23
7/30/2012	460	106	0-3"	1.24
8/21/2013	460	106	0-2"	1.08
8/21/2013	460	106	2-4"	1.40
7/30/2012	460	201	0-3"	1.23
8/21/2013	460	201	0-2"	1.08
8/21/2013	460	201	2-4"	1.43
7/30/2012	460	306	0-3"	1.06
8/21/2013	460	306	0-2"	1.12
8/21/2013	460	306	2-4"	1.24
7/30/2012	460	401	0-3"	1.07
8/21/2013	460	401	0-2"	1.16
8/21/2013	460	401	2-4"	1.17
7/30/2012	620	107	0-3"	1.23
8/21/2013	620	107	0-2"	1.26
8/21/2013	620	107	2-4"	1.40
7/30/2012	620	202	0-3"	1.19

Date	Mix	Plot	Depth	Bulk Density (g/cm <sup>3</sup> )
8/21/2013	620	202	0-2"	1.13
8/21/2013	620	202	2-4"	1.50
7/30/2012	620	302	0-3"	1.17
8/21/2013	620	302	0-2"	1.09
8/21/2013	620	302	2-4"	1.07
7/30/2012	620	410	0-3"	1.04
8/21/2013	620	410	0-2"	0.99
8/21/2013	620	410	2-4"	1.11
7/30/2012	640	108	0-3"	1.22
8/21/2013	640	108	0-2"	1.14
8/21/2013	640	108	2-4"	1.24
7/30/2012	640	208	0-3"	1.09
8/21/2013	640	208	0-2"	1.11
8/21/2013	640	208	2-4"	1.25
7/30/2012	640	309	0-3"	1.05
8/21/2013	640	309	0-2"	1.01
8/21/2013	640	309	2-4"	1.30
7/30/2012	640	403	0-3"	1.16
8/21/2013	640	403	0-2"	1.17
8/21/2013	640	403	2-4"	1.25
7/30/2012	660	109	0-3"	1.24
8/21/2013	660	109	0-2"	1.14
8/21/2013	660	109	2-4"	1.21
7/30/2012	660	206	0-3"	1.21
8/21/2013	660	206	0-2"	1.10
8/21/2013	660	206	2-4"	1.37
7/30/2012	660	303	0-3"	1.02
8/21/2013	660	303	0-2"	0.94
8/21/2013	660	303	2-4"	1.19
7/30/2012	660	408	0-3"	1.13
8/21/2013	660	408	0-2"	1.16
8/21/2013	660	408	2-4"	1.19
7/30/2012	1000	110	0-3"	1.14
8/21/2013	1000	110	0-2"	1.12
8/21/2013	1000	110	2-4"	1.22
7/30/2012	1000	207	0-3"	1.20
8/21/2013	1000	207	0-2"	1.16
8/21/2013	1000	207	2-4"	1.29
7/30/2012	1000	305	0-3"	1.00

Date	Mix	Plot	Depth	Bulk Density (g/cm <sup>3</sup> )
8/21/2013	1000	305	0-2"	1.08
8/21/2013	1000	305	2-4"	1.08
7/30/2012	1000	406	0-3"	1.19
8/21/2013	1000	406	0-2"	1.16
8/21/2013	1000	406	2-4"	1.24

**Table CC-3. Soil moisture, temperature, and resistance**

Time	Date	Mix	Plot	Soil Moisture VWC%	Soil Moisture % or $\mu$ s	Soil Temperature F°	Resistance psi
Ccplanting	7/30/2012	220	101	13.40		90.54	288
CCTerm	9/25/2012	220	101	12.40		52.64	
Barley plant	5/13/2013	220	101	18.24	1.40	58.20	
Ccplanting	8/20/2013	220	101	10.34	1.28	78.58	290
CCterm	10/31/2013	220	101	23.54	1.48	39.60	
Ccplanting	7/30/2012	220	205	12.20		76.16	300
CCTerm	9/25/2012	220	205	12.80		53.64	
Barley plant	5/13/2013	220	205	16.20	1.37	60.00	
Ccplanting	8/20/2013	220	205	6.50	1.22	73.00	300
CCterm	10/31/2013	220	205	24.84	1.49	39.20	
Ccplanting	7/30/2012	220	307	17.60		81.38	278
CCTerm	9/25/2012	220	307	18.40		54.88	
Barley plant	5/13/2013	220	307	13.36	1.32	61.00	
Ccplanting	8/20/2013	220	307	6.32	1.21	74.80	260
CCterm	10/31/2013	220	307	23.84	1.48	40.00	
Ccplanting	7/30/2012	220	405	17.20		79.98	292
CCTerm	9/25/2012	220	405	16.00		54.10	
Barley plant	5/13/2013	220	405	17.74	1.39	55.80	
Ccplanting	8/20/2013	220	405	6.98	1.22	73.80	280
CCterm	10/31/2013	220	405	24.88	1.50	38.80	
Ccplanting	7/30/2012	240	102	15.00		91.04	284
CCTerm	9/25/2012	240	102	13.20		52.92	
Barley plant	5/13/2013	240	102	17.82	1.39	57.40	
Ccplanting	8/20/2013	240	102	10.12	1.28	76.40	345
CCterm	10/31/2013	240	102	25.54	1.50	39.60	
Ccplanting	7/30/2012	240	210	15.60		77.30	286
CCTerm	9/25/2012	240	210	15.60		52.92	
Barley plant	5/13/2013	240	210	17.70	1.39	57.40	
Ccplanting	8/20/2013	240	210	5.88	1.20	72.80	275

Time	Date	Mix	Plot	Soil Moisture VWC%	Soil Moisture % or $\mu$ s	Soil Temperature F°	Resistance psi
CCterm	10/31/2013	240	210	26.94	1.53	38.00	
Ccplanting	7/30/2012	240	304	16.00		80.34	260
CCTerm	9/25/2012	240	304	16.20		52.82	
Barley plant	5/13/2013	240	304	13.60	1.33	60.20	
Ccplanting	8/20/2013	240	304	6.88	1.22	72.80	265
CCterm	10/31/2013	240	304	25.74	1.51	39.60	
Ccplanting	7/30/2012	240	409	15.00		79.34	255
CCTerm	9/25/2012	240	409	15.60		53.30	
Barley plant	5/13/2013	240	409	15.90	1.36	54.40	
Ccplanting	8/20/2013	240	409	7.16	1.23	75.00	295
CCterm	10/31/2013	240	409	23.16	1.47	39.60	
Ccplanting	7/30/2012	260	103	14.00		92.52	300
CCTerm	9/25/2012	260	103	15.60		50.98	
Barley plant	5/13/2013	260	103	17.38	1.39	57.60	
Ccplanting	8/20/2013	260	103	7.30	1.23	73.80	310
CCterm	10/31/2013	260	103	23.22	1.47	39.20	
Ccplanting	7/30/2012	260	203	16.20		77.14	258
CCTerm	9/25/2012	260	203	13.00		54.58	
Barley plant	5/13/2013	260	203	13.70	1.33	59.60	
Ccplanting	8/20/2013	260	203	5.40	1.20	72.80	285
CCterm	10/31/2013	260	203	21.04	1.44	37.80	
Ccplanting	7/30/2012	260	301	15.20		80.62	290
CCTerm	9/25/2012	260	301	14.00		51.62	
Barley plant	5/13/2013	260	301	16.68	1.38	58.60	
Ccplanting	8/20/2013	260	301	7.58	1.23	72.20	240
CCterm	10/31/2013	260	301	24.72	1.49	39.20	
Ccplanting	7/30/2012	260	402	15.80		79.94	265
CCTerm	9/25/2012	260	402	15.60		51.08	
Barley plant	5/13/2013	260	402	16.02	1.37	56.60	
Ccplanting	8/20/2013	260	402	6.70	1.22	73.20	240
CCterm	10/31/2013	260	402	25.38	1.50	38.80	
Ccplanting	7/30/2012	420	104	15.20		92.34	296
CCTerm	9/25/2012	420	104	16.80		51.86	
Barley plant	5/13/2013	420	104	15.82	1.36	59.00	
Ccplanting	8/20/2013	420	104	7.06	1.22	73.60	300
CCterm	10/31/2013	420	104	24.58	1.49	38.80	
Ccplanting	7/30/2012	420	204	13.40		76.62	284
CCTerm	9/25/2012	420	204	12.80		54.16	
Barley plant	5/13/2013	420	204	16.82	1.38	59.60	

Time	Date	Mix	Plot	Soil Moisture VWC%	Soil Moisture % or $\mu$ s	Soil Temperature F°	Resistance psi
Ccplanting	8/20/2013	420	204	7.06	1.23	72.20	290
CCterm	10/31/2013	420	204	24.20	1.49	38.00	
Ccplanting	7/30/2012	420	308	15.80		81.70	266
CCTerm	9/25/2012	420	308	15.40		53.76	
Barley plant	5/13/2013	420	308	15.30	1.39	61.20	
Ccplanting	8/20/2013	420	308	6.64	1.22	76.20	280
CCterm	10/31/2013	420	308	23.08	1.47	39.20	
Ccplanting	7/30/2012	420	404	15.40		79.48	277
CCTerm	9/25/2012	420	404	16.20		53.12	
Barley plant	5/13/2013	420	404	16.80	1.38	57.20	
Ccplanting	8/20/2013	420	404	7.52	1.23	73.80	280
CCterm	10/31/2013	420	404	26.22	1.52	39.20	
Ccplanting	7/30/2012	440	105	15.60		90.78	290
CCTerm	9/25/2012	440	105	14.80		51.22	
Barley plant	5/13/2013	440	105	16.32	1.37	60.20	
Ccplanting	8/20/2013	440	105	7.62	1.23	73.00	210
CCterm	10/31/2013	440	105	22.78	1.46	38.80	
Ccplanting	7/30/2012	440	209	17.40		76.88	246
CCTerm	9/25/2012	440	209	16.00		51.92	
Barley plant	5/13/2013	440	209	17.66	1.39	57.80	
Ccplanting	8/20/2013	440	209	7.30	1.23	72.40	270
CCterm	10/31/2013	440	209	27.38	1.53	38.40	
Ccplanting	7/30/2012	440	310	15.80		82.52	254
CCTerm	9/25/2012	440	310	13.40		54.92	
Barley plant	5/13/2013	440	310	16.94	1.38	59.40	
Ccplanting	8/20/2013	440	310	5.92	1.20	75.00	275
CCterm	10/31/2013	440	310	26.20	1.51	39.20	
Ccplanting	7/30/2012	440	407	15.60		79.86	289
CCTerm	9/25/2012	440	407	14.60		54.92	
Barley plant	5/13/2013	440	407	14.92	1.35	57.20	
Ccplanting	8/20/2013	440	407	6.54	1.22	75.80	290
CCterm	10/31/2013	440	407	23.22	1.47	39.60	
Ccplanting	7/30/2012	460	106	15.40		90.98	258
CCTerm	9/25/2012	460	106	14.40		50.90	
Barley plant	5/13/2013	460	106	16.86	1.38	58.40	
Ccplanting	8/20/2013	460	106	9.12	1.26	73.00	265
CCterm	10/31/2013	460	106	23.82	1.48	38.40	
Ccplanting	7/30/2012	460	201	16.00		76.78	224
CCTerm	9/25/2012	460	201	14.00		53.70	

Time	Date	Mix	Plot	Soil Moisture VWC%	Soil Moisture % or $\mu$ s	Soil Temperature F°	Resistance psi
Barley plant	5/13/2013	460	201	17.00	1.38	60.00	
Ccplanting	8/20/2013	460	201	6.00	1.21	72.20	290
CCterm	10/31/2013	460	201	24.38	1.49	37.20	
Ccplanting	7/30/2012	460	306	15.80		80.80	270
CCTerm	9/25/2012	460	306	15.20		53.48	
Barley plant	5/13/2013	460	306	14.08	1.34	60.60	
Ccplanting	8/20/2013	460	306	6.68	1.22	75.20	290
CCterm	10/31/2013	460	306	23.64	1.48	39.20	
Ccplanting	7/30/2012	460	401	14.20		79.86	268
CCTerm	9/25/2012	460	401	16.00		52.32	
Barley plant	5/13/2013	460	401	14.98	1.35	58.80	
Ccplanting	8/20/2013	460	401	7.42	1.23	75.80	285
CCterm	10/31/2013	460	401	26.50	1.52	38.00	
Ccplanting	7/30/2012	620	107	14.80		91.58	260
CCTerm	9/25/2012	620	107	16.20		52.46	
Barley plant	5/13/2013	620	107	18.10	1.40	59.20	
Ccplanting	8/20/2013	620	107	9.68	1.27	72.60	270
CCterm	10/31/2013	620	107	23.98	1.48	38.40	
Ccplanting	7/30/2012	620	202	17.80		76.78	260
CCTerm	9/25/2012	620	202	12.40		53.90	
Barley plant	5/13/2013	620	202	17.04	1.38	60.80	
Ccplanting	8/20/2013	620	202	5.82	1.20	72.00	270
CCterm	10/31/2013	620	202	23.32	1.47	38.00	
Ccplanting	7/30/2012	620	302	19.20		80.50	270
CCTerm	9/25/2012	620	302	17.40		52.52	
Barley plant	5/13/2013	620	302	15.36	1.36	59.60	
Ccplanting	8/20/2013	620	302	7.72	1.24	72.80	260
CCterm	10/31/2013	620	302	25.60	1.51	38.80	
Ccplanting	7/30/2012	620	410	17.20		79.28	252
CCTerm	9/25/2012	620	410	16.80		52.58	
Barley plant	5/13/2013	620	410	16.28	1.37	54.00	
Ccplanting	8/20/2013	620	410	6.70	1.22	74.80	275
CCterm	10/31/2013	620	410	23.46	1.47	40.00	
Ccplanting	7/30/2012	640	108	12.40		92.04	280
CCTerm	9/25/2012	640	108	14.20		52.76	
Barley plant	5/13/2013	640	108	16.14	1.37	58.20	
Ccplanting	8/20/2013	640	108	7.38	1.23	73.60	235
CCterm	10/31/2013	640	108	24.06	1.48	39.60	
Ccplanting	7/30/2012	640	208	14.80		76.82	300

Time	Date	Mix	Plot	Soil Moisture VWC%	Soil Moisture % or $\mu$ s	Soil Temperature F°	Resistance psi
CCTerm	9/25/2012	640	208	15.40		52.12	
Barley plant	5/13/2013	640	208	17.58	1.39	57.40	
Ccplanting	8/20/2013	640	208	7.12	1.23	72.20	250
CCTerm	10/31/2013	640	208	24.96	1.50	38.40	
Ccplanting	7/30/2012	640	309	16.60		83.16	258
CCTerm	9/25/2012	640	309	12.80		54.24	
Barley plant	5/13/2013	640	309	14.04	1.34	61.40	
Ccplanting	8/20/2013	640	309	6.26	1.21	75.00	260
CCTerm	10/31/2013	640	309	24.62	1.49	39.20	
Ccplanting	7/30/2012	640	403	18.60		90.08	292
CCTerm	9/25/2012	640	403	14.80		51.72	
Barley plant	5/13/2013	640	403	15.98	1.37	57.40	
Ccplanting	8/20/2013	640	403	9.66	1.27	74.40	290
CCTerm	10/31/2013	640	403	27.10	1.53	38.40	
Ccplanting	7/30/2012	660	109	14.60		91.58	280
CCTerm	9/25/2012	660	109	14.00		52.74	
Barley plant	5/13/2013	660	109	16.08	1.37	59.20	
Ccplanting	8/20/2013	660	109	6.64	1.22	73.40	280
CCTerm	10/31/2013	660	109	25.36	1.50	39.20	
Ccplanting	7/30/2012	660	206	13.20		76.52	252
CCTerm	9/25/2012	660	206	15.20		52.40	
Barley plant	5/13/2013	660	206	14.96	1.35	58.40	
Ccplanting	8/20/2013	660	206	7.10	1.23	73.00	270
CCTerm	10/31/2013	660	206	23.30	1.47	38.40	
Ccplanting	7/30/2012	660	303	16.80		81.32	290
CCTerm	9/25/2012	660	303	16.60		51.04	
Barley plant	5/13/2013	660	303	15.78	1.36	60.20	
Ccplanting	8/20/2013	660	303	8.08	1.24	73.20	260
CCTerm	10/31/2013	660	303	25.66	1.51	38.80	
Ccplanting	7/30/2012	660	408	14.60		79.52	283
CCTerm	9/25/2012	660	408	13.80		54.22	
Barley plant	5/13/2013	660	408	14.62	1.35	55.60	
Ccplanting	8/20/2013	660	408	6.20	1.21	76.00	295
CCTerm	10/31/2013	660	408	22.92	1.47	39.20	
Ccplanting	7/30/2012	1000	110	13.20		92.26	273
CCTerm	9/25/2012	1000	110	18.80		53.92	
Barley plant	5/13/2013	1000	110	18.28	1.40	62.40	
Ccplanting	8/20/2013	1000	110	6.78	1.22	75.60	280
CCTerm	10/31/2013	1000	110	22.66	1.46	38.40	

Time	Date	Mix	Plot	Soil Moisture VWC%	Soil Moisture % or $\mu$ s	Soil Temperature F°	Resistance psi
Ccplanting	7/30/2012	1000	207	16.60		77.56	260
CCTerm	9/25/2012	1000	207	24.00		54.88	
Barley plant	5/13/2013	1000	207	18.46	1.40	59.20	
Ccplanting	8/20/2013	1000	207	7.28	1.23	72.80	295
CCterm	10/31/2013	1000	207	25.08	1.50	38.00	
Ccplanting	7/30/2012	1000	305	15.20		80.48	258
CCTerm	9/25/2012	1000	305	22.20		54.52	
Barley plant	5/13/2013	1000	305	15.68	1.36	61.60	
Ccplanting	8/20/2013	1000	305	6.46	1.21	74.40	275
CCterm	10/31/2013	1000	305	23.64	1.48	39.20	
Ccplanting	7/30/2012	1000	406	16.60		79.94	273
CCTerm	9/25/2012	1000	406	17.80		54.94	
Barley plant	5/13/2013	1000	406	17.02	1.38	57.40	
Ccplanting	8/20/2013	1000	406	6.48	1.22	75.40	280
CCterm	10/31/2013	1000	406	23.10	1.47	38.80	

**CC-4. Biological analysis**

Mix	Plot	Date	N lbs per acre	P2O5 lbs per acre	K2O lbs per acre	NO3-N Only (traditional testing) lbs per acre	Additional N (SHT) lbs per acre	Solvita 1-day CO2-C	Organic C	Organic N	Organic C:N	Soil Health Calculation	Total Nitrogen lbs/acre	Inorganic N	Organic N	Total Phosphate lbs/acre	Inorganic P	Organic P
220	101	7/30/12	186.92	399.75	631.80			24.2	284	30.9	9.2	8.6	247.44	185.62	61.81	549.70	395.73	154
220	101	9/25/12	144.93	460.07	673.40			21.65	312.21	35.1	8.9	9.1	216.90	146.66	70.24	623.30	456.34	167
220	101	5/13/13	73.30	456.32	642.39	44.07	29.23	36.56	376.49	37.82	9.96	11.22	122.82	47.18	75.63	521.79	449.34	72.45
220	101	8/20/13	48.31	398.37	559.22	23.16	25.15	34.16	306.58	32.35	9.48	9.91	87.99	23.29	64.71	446.60	391.52	55.08
220	101	10/31/13	30.01	336.21	462.77	6.35	23.65	25.66	317.96	30.56	10.40	8.70	67.87	6.75	61.12	393.95	331.54	62.40
220	205	7/30/12	244.37	385.41	787.80			27.74	338.67	32.7	10.4	9.3	299.67	234.24	65.43	547.40	381.44	166
220	205	9/25/12	145.50	472.54	759.20			32.76	374.85	52.4	7.2	13.6	230.12	125.42	104.70	593.40	465.76	127.6
220	205	5/13/13	83.55	524.82	799.19	33.91	49.64	70.48	478.73	46.93	10.20	16.39	134.82	40.97	93.85	516.04	511.71	4.33
220	205	8/20/13	59.52	505.84	792.29	37.87	21.65	31.85	382.53	40.92	9.35	11.33	120.41	38.56	81.85	503.23	499.37	3.86
220	205	10/31/13	52.24	458.78	588.20	14.45	37.79	32.90	389.71	40.50	9.62	11.37	97.91	16.91	81.00	456.08	452.28	3.80
220	307	7/30/12	428.27	606.12	1051.70			49.57	387.08	37.2	10.4	12.3	482.12	407.82	74.30	821.10	599.10	222
220	307	9/25/12	334.58	554.80	913.90			29.2	390.79	72.1	5.4	16.5	468.20	323.92	144.28	660.10	547.75	112.4
220	307	5/13/13	76.83	620.46	917.00	35.94	40.89	56.30	563.74	53.53	10.53	16.34	148.75	41.69	107.06	618.00	610.36	7.63
220	307	8/20/13	84.94	633.30	896.31	61.99	22.95	33.26	449.44	44.66	10.06	12.26	152.32	63.00	89.32	709.78	627.02	82.76
220	307	10/31/13	55.80	597.65	611.01	15.96	39.84	56.52	349.22	35.68	9.79	12.84	89.18	17.81	71.37	615.91	586.67	29.24
220	405	7/30/12	298.68	500.65	884.00			30.73	394.67	46.3	8.5	12.2	399.18	306.55	92.63	671.60	495.14	176.5
220	405	9/25/12	292.78	519.31	828.10			27.74	387.58	67.1	5.8	15.4	410.38	276.14	134.24	607.20	512.80	94.4
220	405	5/13/13	83.79	601.11	903.67	29.91	53.88	81.52	514.30	48.15	10.68	17.59	131.49	35.18	96.31	591.78	586.73	5.04
220	405	8/20/13	88.58	594.22	800.41	60.68	27.90	43.03	357.05	36.48	9.79	11.61	134.77	61.82	72.95	602.27	585.86	16.40
220	405	10/31/13	61.93	551.90	602.71	21.66	40.27	52.30	370.40	37.42	9.90	12.73	100.26	25.41	74.85	563.93	541.85	22.08
240	102	7/30/12	242.83	374.55	757.90			21.56	312.92	29.4	10.6	8.1	316.18	257.32	58.86	515.20	371.58	143.6
240	102	5/13/13	77.82	457.09	595.29	56.30	21.52	24.08	414.47	42.47	9.76	10.86	146.78	61.83	84.95	502.84	452.40	50.45
240	102	8/20/13	60.03	451.02	697.63	37.10	22.93	35.11	360.12	36.47	9.87	10.80	109.66	36.73	72.94	484.33	444.26	40.07
240	102	10/31/13	54.83	388.05	521.54	11.73	43.10	41.97	410.43	42.06	9.76	12.61	96.68	12.56	84.12	442.31	379.87	62.44
240	210	7/30/12	390.33	474.41	902.20			41.79	372.66	39.4	9.5	12.1	440.95	362.22	78.72	660.10	467.69	192.4
240	210	9/25/12	205.28	552.08	828.10			37.4	415.29	61.5	6.8	15.9	293.10	170.04	123.06	676.20	544.04	132.2

Mix	Plot	Date	N lbs per acre	P2O5 lbs per acre	K2O lbs per acre	NO3-N Only (traditional testing) lbs per acre	Additional N (SHT) lbs per acre	Solvita 1-day CO2-C	Organic C	Organic N	Organic C:N	Soil Health Calculation	Total Nitrogen lbs/acre	Inorganic N	Organic N	Total Phosphate lbs/acre	Inorganic P	Organic P
240	210	5/13/13	85.86	588.32	898.70	38.11	47.75	61.92	524.65	55.22	9.50	17.29	155.93	45.49	110.44	585.25	575.93	9.32
240	210	8/20/13	71.85	572.69	828.66	50.00	21.85	33.06	365.70	37.55	9.74	10.81	125.42	50.31	75.11	574.43	566.24	8.19
240	210	10/31/13	62.30	550.54	644.92	19.10	43.20	39.86	390.14	41.07	9.50	12.21	103.19	21.05	82.15	554.20	542.56	11.64
240	304	7/30/12	437.75	534.97	1077.70			38.7	431	40.9	10.5	12.1	514.77	432.96	81.80	742.90	529.59	213.3
240	304	9/25/12	347.61	545.80	956.80			37.4	455.98	79.3	5.8	19.0	468.96	310.44	158.52	660.10	537.01	123.1
240	304	5/13/13	86.06	638.82	968.20	36.22	49.84	68.34	606.72	59.75	10.15	18.77	163.79	44.30	119.49	645.71	626.05	19.67
240	304	8/20/13	93.99	604.61	821.65	53.06	40.92	63.04	386.66	40.19	9.62	14.44	134.05	53.67	80.38	601.80	592.15	9.65
240	304	10/31/13	60.92	561.72	636.86	20.53	40.39	40.19	382.54	39.59	9.66	11.94	101.54	22.36	79.18	573.05	553.81	19.24
240	409	7/30/12	329.49	557.97	949.00			38.7	393.78	47.0	8.4	13.3	394.77	300.81	93.96	736.00	550.91	185.1
240	409	9/25/12	293.64	494.01	894.40			32.76	378.2	65.9	5.7	16.1	377.40	245.56	131.84	607.20	486.30	120.9
240	409	5/13/13	93.54	603.24	939.75	40.03	53.50	77.90	559.74	54.08	10.35	18.53	153.06	44.90	108.16	598.40	588.98	9.41
240	409	8/20/13	67.18	534.55	767.76	46.12	21.06	33.55	388.90	38.71	10.05	11.10	123.23	45.80	77.43	535.10	528.20	6.90
240	409	10/31/13	43.46	429.70	587.57	11.66	31.80	34.31	368.79	35.61	10.36	10.56	85.78	14.56	71.22	440.64	423.42	17.22
260	103	7/30/12	316.19	393.26	895.70			36.92	355.25	37.0	9.6	11.1	379.29	305.30	74.00	545.10	387.43	157.7
260	103	9/25/12	156.41	435.03	925.60			30.99	409.56	46.3	8.9	12.2	236.08	143.52	92.56	586.50	429.67	156.8
260	103	5/13/13	93.59	528.08	706.09	40.24	53.35	79.08	458.64	45.17	10.15	16.89	135.67	45.34	90.33	562.22	513.30	48.92
260	103	8/20/13	72.11	563.43	629.17	36.24	35.87	52.78	376.85	39.93	9.44	13.35	117.55	37.69	79.86	601.80	552.81	49.00
260	103	10/31/13	44.81	489.81	464.78	15.96	28.85	31.35	331.95	33.56	9.89	9.85	85.41	18.29	67.12	547.51	483.79	63.72
260	203	7/30/12	322.60	387.10	821.60			33.04	347.9	26.7	13.1	8.7	382.94	329.62	53.32	552.00	384.16	167.8
260	203	5/13/13	70.12	544.76	810.29	27.76	42.36	59.67	485.19	47.76	10.16	15.50	128.61	33.08	95.53	536.67	533.61	3.06
260	203	8/20/13	71.35	450.72	618.18	41.99	29.36	46.67	329.27	33.48	9.83	11.39	108.16	41.20	66.96	448.38	441.70	6.68
260	203	10/31/13	46.76	345.38	455.89	11.77	34.99	45.09	337.45	34.52	9.78	11.44	82.14	13.10	69.04	345.55	336.61	8.94
260	301	7/30/12	344.97	554.20	980.20			39.7	393.68	42.9	9.2	12.6	400.73	314.85	85.88	763.60	547.58	216
260	301	9/25/12	205.55	481.42	876.20			32.76	433.59	66.5	6.5	16.0	314.34	181.38	132.96	595.70	474.23	121.5
260	301	5/13/13	84.10	659.89	961.19	38.74	45.36	61.75	565.16	55.72	10.14	17.31	157.40	45.97	111.43	667.56	648.34	19.22
260	301	8/20/13	88.44	587.16	902.49	55.77	32.68	48.37	415.95	44.13	9.43	13.70	145.04	56.78	88.26	596.09	577.41	18.67
*	301	10/31/13	57.98	478.45	656.54	21.25	36.73	39.46	376.29	37.49	10.04	11.44	98.16	23.19	74.97	475.48	470.98	4.50
260	402	7/30/12	406.75	555.18	923.00			35.08	392.1	50.5	7.8	13.5	499.09	398.11	100.98	644.00	548.35	95.65

Mix	Plot	Date	N lbs per acre	P2O5 lbs per acre	K2O lbs per acre	NO3-N Only (traditional testing) lbs per acre	Additional N (SHT) lbs per acre	Solvita 1-day CO2-C	Organic C	Organic N	Organic C:N	Soil Health Calculation	Total Nitrogen lbs/acre	Inorganic N	Organic N	Total Phosphate lbs/acre	Inorganic P	Organic P
260	402	9/25/12	216.10	523.67	846.30			30.73	369.08	58.7	6.3	14.5	310.52	193.14	117.38	637.10	516.78	120.3
260	402	5/13/13	67.53	572.20	888.59	35.09	32.44	41.41	491.94	47.49	10.36	13.67	135.37	40.39	94.98	565.46	564.63	0.83
260	402	8/20/13	102.36	568.24	753.61	72.18	30.18	48.24	373.02	36.80	10.14	12.17	146.21	72.62	73.59	583.19	559.21	23.98
260	402	10/31/13	57.16	533.29	581.82	18.46	38.70	54.98	349.45	35.32	9.89	12.58	91.99	21.34	70.65	541.29	522.73	18.57
420	104	7/30/12	286.42	354.64	811.20			39.36	347.19	39.5	8.8	11.9	400.45	321.51	78.94	480.70	347.79	132.9
420	104	9/25/12	241.41	416.25	917.80			32.76	395.21	47.5	8.3	12.6	335.70	240.70	95.00	565.80	410.24	155.6
420	104	5/13/13	88.91	528.01	725.50	40.27	48.64	69.06	520.74	50.78	10.25	17.02	146.89	45.33	101.56	566.51	515.24	51.27
420	104	8/20/13	83.68	503.12	646.20	53.50	30.17	42.08	344.77	36.47	9.45	11.55	129.98	57.04	72.94	537.26	494.66	42.60
420	104	10/31/13	51.09	436.34	598.85	13.61	37.49	40.98	381.46	38.42	9.93	11.78	91.49	14.66	76.83	482.12	428.50	53.61
420	204	7/30/12	273.03	370.18	772.20			38.7	339.72	33.5	10.1	10.6	316.22	249.20	67.02	512.90	364.49	148.4
420	204	9/25/12	120.48	400.55	700.70			27.15	383.59	50.1	7.7	12.4	209.80	109.58	100.22	503.70	395.21	108.5
420	204	5/13/13	78.05	507.92	809.32	33.78	44.27	62.49	489.91	47.44	10.33	15.69	134.53	39.65	94.88	503.09	496.46	6.63
420	204	8/20/13	73.95	468.63	708.85	50.32	23.63	34.98	326.32	34.78	9.38	10.47	118.60	49.03	69.57	463.37	461.55	1.82
420	204	10/31/13	49.30	425.68	550.10	14.42	34.88	38.27	334.15	35.82	9.33	11.03	86.21	14.58	71.64	419.01	417.90	1.11
420	308	7/30/12	477.52	591.88	1094.60			44.55	424.26	73.7	5.8	19.4	512.39	365.00	147.39	828.00	581.42	246.6
420	308	9/25/12	351.75	570.37	1040.00			29.2	450.55	74.7	6.0	16.8	469.22	319.76	149.46	685.40	563.67	121.7
420	308	5/13/13	87.55	635.36	976.47	36.89	50.66	73.08	594.55	56.07	10.60	18.44	156.77	44.64	112.13	635.80	622.35	13.45
420	308	8/20/13	127.81	665.12	893.54	89.71	38.10	56.90	420.20	42.35	9.92	14.17	174.80	90.10	84.71	736.00	654.22	81.78
420	308	10/31/13	71.58	674.97	718.78	16.54	55.05	48.02	462.51	48.08	9.62	14.43	115.35	19.19	96.16	711.75	665.48	46.27
420	404	7/30/12	343.46	505.67	920.40			44.55	391.85	46.3	8.5	13.8	425.25	332.72	92.53	673.90	497.62	176.3
420	404	9/25/12	328.25	609.15	930.80			38.7	392.36	67.7	5.8	17.4	413.60	278.12	135.48	724.50	600.09	124.4
420	404	5/13/13	103.67	453.85	836.13	68.16	35.51	70.75	608.41	45.06	13.50	15.83	224.43	134.32	90.12	449.73	445.36	4.36
420	404	8/20/13	95.79	594.50	813.13	71.59	24.20	35.86	371.31	38.55	9.63	11.29	147.74	70.65	77.09	631.64	587.42	44.22
420	404	10/31/13	64.67	524.52	603.50	20.97	43.70	55.06	384.30	40.12	9.58	13.60	103.88	23.65	80.23	532.96	513.59	19.37
440	105	7/30/12	319.23	463.49	917.80			29.2	387.29	46.2	8.4	12.0	412.83	320.53	92.31	637.10	458.18	178.9
440	105	9/25/12	232.31	425.86	930.80			27.62	392.17	44.2	8.9	11.5	316.50	228.14	88.36	588.80	421.09	167.7
440	105	5/13/13	83.19	591.92	721.18	30.34	52.86	77.65	490.92	48.66	10.09	17.47	131.23	33.91	97.32	629.12	577.30	51.82
440	105	8/20/13	57.03	563.72	602.96	36.21	20.82	29.67	368.84	39.78	9.27	10.87	117.97	38.40	79.57	607.29	557.65	49.64

Mix	Plot	Date	N lbs per acre	P2O5 lbs per acre	K2O lbs per acre	NO3-N Only (traditional testing) lbs per acre	Additional N (SHT) lbs per acre	Solvita 1-day CO2-C	Organic C	Organic N	Organic C:N	Soil Health Calculation	Total Nitrogen lbs/acre	Inorganic N	Organic N	Total Phosphate lbs/acre	Inorganic P	Organic P
440	105	10/31/13	54.44	463.56	573.69	11.57	42.87	39.62	403.26	42.55	9.48	12.47	98.74	13.64	85.10	472.19	455.62	16.58
440	209	7/30/12	373.92	502.86	963.30			16.13	380.35	37.1	10.3	9.1	456.54	382.32	74.22	694.60	500.52	194.1
440	209	9/25/12	245.22	501.60	846.30			33.04	405.99	64.1	6.3	15.7	354.56	226.44	128.12	627.90	494.22	133.7
440	209	5/13/13	141.95	608.02	934.37	77.51	64.44	102.25	557.63	51.19	10.89	20.08	190.60	88.22	102.38	600.68	590.42	10.26
440	209	8/20/13	89.04	567.64	813.11	50.06	38.98	57.72	404.47	43.17	9.37	14.52	136.67	50.32	86.35	576.39	555.95	20.44
440	209	10/31/13	72.66	533.31	596.22	21.48	51.18	48.62	399.26	42.49	9.40	13.41	110.43	25.46	84.97	550.17	523.49	26.69
440	310	7/30/12	438.62	537.10	1132.30			36.92	418.67	44.3	9.5	12.5	507.77	419.22	88.55	729.10	531.16	197.9
440	310	9/25/12	321.70	518.78	972.40			30.73	404.65	72.6	5.6	16.8	433.96	288.70	145.26	616.40	511.45	105
440	310	5/13/13	89.82	765.79	1034.88	39.38	50.44	71.49	560.74	53.34	10.51	17.74	151.92	45.24	106.68	773.56	752.94	20.61
440	310	8/20/13	121.65	691.24	974.40	89.32	32.33	51.10	477.25	46.18	10.33	14.34	185.03	92.67	92.36	814.20	681.88	132.32
440	310	10/31/13	80.42	656.36	732.57	31.30	49.12	72.76	438.43	44.26	9.91	16.16	123.40	34.88	88.52	678.42	642.39	36.03
440	407	7/30/12	351.53	489.07	945.10			27.74	366.18	43.2	8.5	11.3	431.33	344.95	86.37	660.10	484.07	176
440	407	9/25/12	209.69	453.25	846.30			25.8	376.89	60.0	6.3	13.9	323.08	203.12	119.96	565.80	447.47	118.3
440	407	5/13/13	81.42	577.96	907.46	40.71	40.71	58.04	513.01	48.64	10.55	15.50	143.79	46.50	97.28	576.17	567.56	8.61
440	407	8/20/13	78.86	541.21	776.37	56.12	22.74	32.51	356.03	38.90	9.15	11.00	134.00	56.20	77.81	556.90	534.48	22.42
440	407	10/31/13	48.62	453.06	568.85	16.95	31.68	33.33	345.96	34.55	10.01	10.24	89.66	20.56	69.10	474.60	446.73	27.87
460	106	9/25/12	187.36	446.34	882.70			35.08	396.92	51.0	7.8	13.6	264.14	162.08	102.06	600.30	439.52	160.8
460	106	5/13/13	105.49	594.93	889.34	57.60	47.89	71.22	516.20	49.04	10.53	16.83	162.68	64.60	98.09	644.47	582.15	62.32
460	106	8/20/13	89.63	534.97	672.95	54.14	35.49	51.80	334.09	36.87	9.06	12.75	128.62	54.88	73.74	570.72	524.15	46.57
460	106	10/31/13	56.89	486.52	613.93	18.34	38.54	42.90	370.99	38.18	9.72	11.94	96.54	20.17	76.37	502.02	478.13	23.90
460	201	7/30/12	378.54	456.16	968.50			38.7	346.75	30.0	11.6	9.8	417.90	357.94	59.97	660.10	451.56	208.5
460	201	9/25/12	262.10	601.57	920.40			34.78	399.11	63.3	6.3	15.8	371.90	245.32	126.58	756.70	593.78	162.9
460	201	5/13/13	87.47	507.31	790.94	51.02	36.45	47.41	445.05	44.11	10.09	13.56	146.91	58.69	88.23	505.32	498.39	6.93
460	201	8/20/13	86.03	500.31	749.27	58.49	27.55	39.26	338.82	37.75	8.98	11.54	131.18	55.69	75.49	493.66	492.04	1.62
460	201	10/31/13	52.73	431.25	536.27	16.15	36.58	38.43	341.17	37.15	9.18	11.31	91.63	17.34	74.29	435.79	423.32	12.47
460	306	7/30/12	399.02	590.15	1019.20			43.8	392.33	39.8	9.9	12.3	455.33	375.77	79.56	786.60	583.46	203.1
460	306	9/25/12	363.90	587.41	959.40			34.78	427.46	81.1	5.3	19.0	490.32	328.10	162.22	722.20	578.90	143.3
460	306	5/13/13	120.78	680.37	1007.41	57.07	63.70	89.70	596.78	59.75	9.99	20.92	185.97	66.47	119.50	685.11	663.31	21.80

Mix	Plot	Date	N lbs per acre	P2O5 lbs per acre	K2O lbs per acre	NO3-N Only (traditional testing) lbs per acre	Additional N (SHT) lbs per acre	Solvita 1-day CO2-C	Organic C	Organic N	Organic C:N	Soil Health Calculation	Total Nitrogen lbs/acre	Inorganic N	Organic N	Total Phosphate lbs/acre	Inorganic P	Organic P
460	306	8/20/13	118.25	603.32	893.75	74.11	44.15	64.64	431.78	46.27	9.33	15.87	166.23	73.68	92.55	634.87	590.17	44.70
460	306	10/31/13	60.22	509.13	643.96	18.50	41.72	42.15	397.53	40.39	9.84	12.30	102.70	21.91	80.79	516.33	500.99	15.34
460	401	7/30/12	334.01	513.69	924.30			42.33	402.08	26.7	15.0	9.5	443.28	389.80	53.48	692.30	511.60	180.7
460	401	9/25/12	271.17	572.33	913.90			47.3	422.57	67.1	6.3	18.4	350.82	216.72	134.10	680.80	561.74	119.1
460	401	5/13/13	66.43	448.73	754.29	22.09	44.34	65.46	508.20	48.67	10.44	16.22	132.28	34.94	97.34	464.53	436.87	27.67
460	401	8/20/13	74.21	569.46	860.05	51.35	22.86	37.91	393.34	37.62	10.46	11.32	125.47	50.24	75.23	619.27	562.61	56.67
460	401	10/31/13	58.26	533.17	709.83	19.96	38.30	48.29	345.36	35.70	9.67	12.02	92.52	21.12	71.41	541.45	523.68	17.77
620	107	7/30/12	389.15	549.34	967.20			39.36	374.17	45.4	8.2	13.1	459.17	368.31	90.86	736.00	542.05	194
620	107	9/25/12	324.84	563.24	942.50			33.04	403.43	54.8	7.4	14.0	412.32	302.78	109.54	736.00	556.55	179.5
620	107	5/13/13	81.57	608.82	881.41	49.17	32.40	40.52	596.04	57.14	10.43	15.56	170.26	55.98	114.28	604.84	601.47	3.36
620	107	8/20/13	85.55	500.71	782.40	50.51	35.04	55.50	364.63	37.11	9.83	13.01	126.88	52.66	74.22	492.20	489.97	2.23
620	107	10/31/13	60.07	476.46	630.07	20.75	39.32	43.38	371.08	38.35	9.67	12.03	99.98	23.27	76.71	470.27	467.93	2.34
620	202	7/30/12	347.11	439.38	924.30			43.8	331.37	25.5	13.0	9.2	402.26	351.17	51.08	616.40	435.41	181
620	202	9/25/12	241.92	574.59	848.90			34.78	402.24	57.1	7.1	14.7	331.92	217.74	114.18	680.80	567.32	113.5
620	202	5/13/13	80.88	517.62	782.35	32.90	47.98	67.78	457.86	44.63	10.26	15.65	125.47	36.22	89.26	505.31	505.10	0.22
620	202	8/20/13	64.96	430.38	688.75	46.31	18.65	26.61	308.49	33.07	9.33	9.24	112.77	46.63	66.14	427.72	424.96	2.76
620	202	10/31/13	46.55	405.17	526.72	11.87	34.68	41.51	339.54	34.98	9.71	11.17	83.22	13.27	69.95	405.16	397.04	8.11
620	302	7/30/12	404.25	490.37	1016.60			43.8	401.75	34.2	11.7	11.2	469.14	400.67	68.47	678.50	485.32	193.2
620	302	9/25/12	284.07	474.29	884.00			34.78	387.42	65.4	5.9	16.3	382.06	251.28	130.78	572.70	466.24	106.5
620	302	5/13/13	110.53	639.75	947.12	51.10	59.43	84.83	592.56	58.67	10.10	20.19	175.73	58.39	117.34	648.53	623.80	24.73
620	302	8/20/13	87.59	595.24	848.77	60.49	27.09	37.95	404.52	44.62	9.07	12.69	148.25	59.01	89.25	602.52	587.32	15.20
620	302	10/31/13	72.92	567.19	651.34	26.41	46.51	39.97	403.51	43.68	9.24	12.73	117.09	29.74	87.35	562.96	558.99	3.97
620	410	7/30/12	405.35	640.96	1064.70			27.39	421.82	54.4	7.8	13.2	498.87	390.05	108.82	853.30	635.62	217.7
620	410	9/25/12	417.60	662.28	945.10			79.96	460.22	85.8	5.4	28.1	511.96	340.34	171.62	717.60	642.87	74.73
620	410	5/13/13	84.33	731.16	1012.67	33.15	51.17	70.90	628.52	61.05	10.29	19.28	163.10	40.99	122.11	732.58	718.10	14.47
620	410	8/20/13	91.60	637.01	884.71	61.65	29.95	46.09	426.02	43.02	9.90	13.22	149.36	63.32	86.04	719.31	628.16	91.15
620	410	10/31/13	59.06	553.77	610.80	19.41	39.65	38.90	383.07	39.33	9.74	11.76	100.17	21.51	78.66	569.01	546.18	22.83
640	108	7/30/12	319.84	435.62	895.70			35.08	386.79	43.7	8.9	12.2	407.21	319.79	87.43	586.50	429.55	157

Mix	Plot	Date	N lbs per acre	P2O5 lbs per acre	K2O lbs per acre	NO3-N Only (traditional testing) lbs per acre	Additional N (SHT) lbs per acre	Solvita 1-day CO2-C	Organic C	Organic N	Organic C:N	Soil Health Calculation	Total Nitrogen lbs/acre	Inorganic N	Organic N	Total Phosphate lbs/acre	Inorganic P	Organic P
640	108	9/25/12	223.63	519.75	924.30			39.7	406.08	51.2	7.9	14.2	307.14	204.70	102.44	680.80	512.15	168.7
640	108	5/13/13	97.24	560.34	867.69	38.54	58.69	91.56	533.70	50.36	10.60	19.01	144.67	43.95	100.72	545.79	544.04	1.76
640	108	8/20/13	76.11	597.01	828.21	45.95	30.16	45.52	360.15	38.28	9.41	12.27	121.60	45.03	76.57	602.52	587.82	14.69
640	108	10/31/13	55.54	543.64	645.11	17.78	37.76	38.64	365.35	38.23	9.56	11.52	96.98	20.52	76.46	551.55	535.96	15.59
640	208	7/30/12	367.58	483.91	878.80			34.78	349.84	41.5	8.4	11.8	384.43	301.51	82.92	657.80	477.61	180.2
640	208	9/25/12	221.83	515.70	843.70			33.04	396.24	58.1	6.8	14.6	311.52	195.26	116.26	630.20	508.64	121.6
640	208	5/13/13	82.80	585.34	868.01	34.94	47.86	68.32	493.05	48.43	10.18	16.48	136.23	39.37	96.86	578.67	572.61	6.06
640	208	8/20/13	96.75	561.91	797.98	69.29	27.45	39.37	358.44	38.66	9.27	11.70	146.66	69.34	77.32	554.01	553.85	0.16
640	208	10/31/13	56.08	522.61	615.92	16.60	39.49	44.13	369.47	37.99	9.73	12.03	94.00	18.03	75.98	519.57	513.98	5.60
640	309	7/30/12	442.72	526.85	1101.10			43.8	389.41	42.2	9.2	12.9	483.60	399.27	84.33	740.60	519.61	221
640	309	9/25/12	255.40	448.71	897.00			25.8	411.38	67.9	6.1	15.2	381.38	245.62	135.76	552.00	442.81	109.2
640	309	5/13/13	92.31	652.04	991.30	44.61	47.70	65.67	582.62	56.37	10.34	17.82	169.04	56.29	112.75	655.98	640.00	15.98
640	309	8/20/13	127.90	673.13	891.26	88.98	38.92	64.96	419.96	38.98	10.77	14.13	164.68	86.72	77.96	779.32	661.79	117.53
640	309	10/31/13	66.32	623.90	668.79	19.08	47.24	20.86	460.12	49.50	9.30	11.80	121.59	22.59	99.00	643.62	619.64	23.98
640	403	7/30/12	358.55	472.58	929.50			39.36	365.52	42.1	8.7	12.4	433.35	349.22	84.13	639.40	465.64	173.8
640	403	9/25/12	195.77	437.57	738.40			22.99	357.42	53.4	6.7	12.4	297.24	190.38	106.86	547.40	432.59	114.8
640	403	5/13/13	90.34	609.44	892.29	52.64	37.70	56.42	485.68	42.94	11.31	14.14	145.38	59.50	85.88	602.12	600.20	1.91
640	403	8/20/13	97.90	589.67	833.62	74.18	23.72	39.71	388.25	36.04	10.77	11.17	147.00	74.91	72.09	607.90	582.73	25.16
640	403	10/31/13	59.93	507.76	574.58	19.10	40.83	46.54	367.51	38.36	9.58	12.37	98.12	21.40	76.72	515.24	498.52	16.71
660	109	7/30/12	366.40	584.69	945.10			36.92	387.42	43.5	8.9	12.4	447.41	360.51	86.90	782.00	578.35	203.7
660	109	9/25/12	241.57	626.06	926.90			33.04	415.95	49.4	8.4	13.0	335.58	236.84	98.74	816.50	620.06	196.4
660	109	5/13/13	111.03	636.30	993.38	57.62	53.41	80.93	512.03	48.73	10.51	17.70	152.94	55.48	97.46	630.98	621.75	9.24
660	109	8/20/13	100.36	566.43	836.09	65.40	34.96	54.56	378.48	38.73	9.77	13.24	143.24	65.78	77.46	564.91	555.81	9.10
660	109	10/31/13	57.10	419.88	631.09	18.70	38.40	47.72	344.05	36.29	9.48	12.10	93.25	20.68	72.57	429.93	410.32	19.61
660	206	7/30/12	342.15	433.85	890.50			39.7	362.34	35.6	10.2	11.1	389.56	318.38	71.18	602.60	428.04	174.6
660	206	9/25/12	149.75	481.66	808.60			29.2	380.75	55.6	6.9	13.6	248.66	137.56	111.10	602.60	475.45	127.2
660	206	5/13/13	67.61	533.07	834.37	33.34	34.28	45.06	500.69	48.83	10.25	14.28	137.11	39.44	97.67	525.07	524.74	0.33
660	206	8/20/13	70.59	488.65	652.34	44.97	25.62	36.68	333.12	36.39	9.16	10.98	116.70	43.93	72.77	481.80	481.06	0.74

Mix	Plot	Date	N lbs per acre	P2O5 lbs per acre	K2O lbs per acre	NO3-N Only (traditional testing) lbs per acre	Additional N (SHT) lbs per acre	Solvita 1-day CO2-C	Organic C	Organic N	Organic C:N	Soil Health Calculation	Total Nitrogen lbs/acre	Inorganic N	Organic N	Total Phosphate lbs/acre	Inorganic P	Organic P
660	206	10/31/13	53.92	457.61	505.63	21.08	32.85	41.93	315.72	32.36	9.76	10.69	87.35	22.63	64.73	457.77	449.44	8.33
660	303	7/30/12	419.45	573.37	1021.80			47.3	386.05	50.1	7.7	15.0	467.36	367.26	100.10	782.00	564.11	217.9
660	303	9/25/12	310.86	584.96	911.30			46.89	403.95	64.2	6.3	17.9	406.88	278.52	128.36	692.30	574.45	117.9
660	303	5/13/13	103.19	634.81	994.20	52.73	50.45	72.30	590.75	56.90	10.38	18.56	172.09	58.29	113.80	640.49	621.62	18.87
660	303	8/20/13	109.42	633.41	867.93	75.63	33.79	50.73	388.39	40.45	9.60	13.21	158.25	77.36	80.90	656.47	623.37	33.10
660	303	10/31/13	67.55	562.95	702.98	21.24	46.31	44.69	407.90	42.95	9.50	13.08	110.27	24.36	85.91	555.60	554.01	1.59
660	408	7/30/12	336.99	442.23	911.30			33.04	377.95	42.6	8.9	11.8	424.44	339.28	85.16	598.00	436.53	161.5
660	408	9/25/12	215.43	427.46	786.50			32.76	378.64	55.9	6.8	14.2	301.86	190.18	111.68	519.80	420.44	99.36
660	408	5/13/13	100.04	620.20	972.28	50.64	49.40	75.24	540.56	50.21	10.77	17.41	155.09	54.67	100.42	609.94	607.06	2.88
660	408	8/20/13	103.08	573.36	835.04	76.22	26.86	40.95	354.65	36.57	9.70	11.43	147.89	74.75	73.14	590.95	565.33	25.61
660	408	10/31/13	49.14	437.84	616.14	18.49	30.64	30.83	342.75	34.84	9.84	10.05	90.42	20.74	69.68	443.29	431.88	11.41
1000	110	7/30/12	334.43	579.72	954.20			36.92	403.68	44.9	9.0	12.6	427.21	337.35	89.87	765.90	573.43	192.5
1000	110	9/25/12	388.87	617.28	1001.00			38.7	388.62	54.3	7.2	14.7	484.70	376.10	108.60	807.30	609.27	198
1000	110	5/13/13	104.53	687.75	982.04	41.47	63.07	93.59	574.18	56.42	10.18	20.58	160.95	48.10	112.84	675.92	670.30	5.62
1000	110	8/20/13	107.03	644.43	861.82	72.07	34.96	51.16	399.26	43.38	9.20	13.89	158.87	72.11	86.76	692.32	633.90	58.43
1000	110	10/31/13	65.12	613.58	654.44	20.74	44.38	43.98	386.88	41.89	9.23	12.82	106.50	22.71	83.79	617.94	604.55	13.39
1000	207	7/30/12	359.09	454.14	902.20			25.8	345.43	24.0	14.4	7.6	413.87	365.92	47.95	632.50	452.55	180
1000	207	9/25/12	311.32	539.00	861.90			27.74	368.52	67.7	5.5	15.5	429.80	294.50	135.30	641.70	532.31	109.4
1000	207	5/13/13	76.85	677.66	957.51	28.23	48.61	68.27	539.17	52.81	10.21	17.36	138.37	32.75	105.62	668.19	664.97	3.22
1000	207	8/20/13	75.99	551.63	794.40	49.75	26.24	38.00	366.50	39.73	9.22	11.76	129.61	50.15	79.46	549.70	543.82	5.88
1000	207	10/31/13	58.96	486.47	630.07	16.79	42.17	40.14	405.92	41.51	9.78	12.32	101.29	18.27	83.03	485.89	478.66	7.22
1000	305	7/30/12	439.92	598.66	1098.50			49.57	405.76	48.2	8.4	14.8	494.63	398.32	96.32	832.60	589.66	242.9
1000	305	9/25/12	421.38	604.70	1032.20			33.04	439.45	93.3	4.7	20.7	572.34	385.84	186.50	724.50	596.25	128.3
1000	305	5/13/13	64.01	555.96	833.68	17.29	46.73	63.55	609.37	62.17	9.80	18.79	155.91	31.57	124.34	553.23	543.64	9.59
1000	305	8/20/13	106.66	655.92	894.60	74.52	32.14	46.68	400.38	40.34	9.92	12.74	157.58	76.89	80.69	747.64	646.98	100.66
1000	305	10/31/13	59.69	550.16	601.77	19.91	39.77	42.79	359.43	37.95	9.47	11.91	99.39	23.49	75.90	572.13	541.58	30.55
1000	406	7/30/12	367.09	493.22	954.20			33.04	373.46	51.5	7.3	13.4	462.86	359.96	102.90	685.40	486.45	199
1000	406	9/25/12	357.34	480.61	872.30			32.9	352.83	68.9	5.1	16.8	460.68	322.90	137.78	595.70	472.46	123.2

Mix	Plot	Date	N lbs per acre	P2O5 lbs per acre	K2O lbs per acre	NO3-N Only (traditional testing) lbs per acre	Additional N (SHT) lbs per acre	Solvita 1-day CO2-C	Organic C	Organic N	Organic C:N	Soil Health Calculation	Total Nitrogen lbs/acre	Inorganic N	Organic N	Total Phosphate lbs/acre	Inorganic P	Organic P
1000	406	5/13/13	71.90	593.17	896.08	27.86	44.04	61.69	511.85	49.62	10.32	16.06	133.51	34.28	99.24	582.51	581.84	0.68
1000	406	8/20/13	89.95	563.33	825.07	67.09	22.87	34.72	357.57	36.82	9.71	10.83	140.78	67.14	73.64	579.00	556.53	22.47
1000	406	10/31/13	48.25	477.28	569.85	18.22	30.03	31.20	339.49	34.06	9.97	9.93	89.23	21.11	68.11	490.55	471.33	19.22

\*Plot 301 accidentally seeded with 460 Mix in 2013

**Table CC-5. Canopy cover and plant height**

Cover Crop Mix	Plot ID	Date	Percentage (1.00=100%)													Plot Height (cm)
			Total Cover	Bare Ground	Weed	Planted Grass	Planted Legume	Planted Forb	Total Planted Cover	Rye/ Triticale	Oat	Clover	Vetch	Rape	Radish	
Triticale, Red clover	101	8/31/12	0.64	0.36	0.06	0.56	0.02	0.00	0.58	0.56	0.00	0.02	0.00	0.00	0.00	11.20
	101	9/18/12	0.92	0.08	0.16	0.74	0.00	0.02	0.76	0.74	0.00	0.00	0.00	0.00	0.02	22.90
	205	8/31/12	0.60	0.40	0.34	0.26	0.00	0.00	0.26	0.26	0.00	0.00	0.00	0.00	0.00	14.00
	205	9/18/12	0.88	0.12	0.22	0.66	0.00	0.00	0.66	0.66	0.00	0.00	0.00	0.00	0.00	35.10
	307	8/31/12	0.68	0.32	0.16	0.50	0.00	0.02	0.52	0.50	0.00	0.00	0.00	0.00	0.02	8.10
	307	9/18/12	0.96	0.04	0.22	0.72	0.00	0.02	0.74	0.72	0.00	0.00	0.00	0.00	0.02	22.90
	405	8/31/12	0.66	0.34	0.34	0.30	0.02	0.00	0.32	0.30	0.00	0.00	0.02	0.00	0.00	15.00
20 seeds/ft2	405	9/18/12	0.94	0.06	0.14	0.80	0.00	0.00	0.80	0.80	0.00	0.00	0.00	0.00	0.00	33.00
Triticale, Red clover	102	8/31/12	0.72	0.28	0.14	0.58	0.00	0.00	0.58	0.58	0.00	0.00	0.00	0.00	0.00	14.00
	102	9/18/12	0.98	0.02	0.04	0.92	0.00	0.02	0.94	0.92	0.00	0.00	0.00	0.00	0.02	28.40
	210	8/31/12	0.66	0.34	0.18	0.48	0.00	0.00	0.48	0.48	0.00	0.00	0.00	0.00	0.00	17.50
	210	9/18/12	0.92	0.08	0.10	0.82	0.00	0.00	0.82	0.82	0.00	0.00	0.00	0.00	0.00	34.50
	304	8/31/12	0.54	0.46	0.14	0.40	0.00	0.00	0.40	0.40	0.00	0.00	0.00	0.00	0.00	13.20
	304	9/18/12	1.00	0.00	0.10	0.90	0.00	0.00	0.90	0.90	0.00	0.00	0.00	0.00	0.00	27.40
	409	8/31/12	0.78	0.22	0.08	0.70	0.00	0.00	0.70	0.70	0.00	0.00	0.00	0.00	0.00	17.80
40 seeds/ft2	409	9/18/12	0.96	0.04	0.04	0.92	0.00	0.00	0.92	0.92	0.00	0.00	0.00	0.00	0.00	33.50
Triticale, Red clover	103	8/31/12	0.74	0.26	0.08	0.64	0.02	0.00	0.66	0.64	0.00	0.02	0.00	0.00	0.00	17.30
	103	9/18/12	0.98	0.02	0.06	0.92	0.00	0.00	0.92	0.92	0.00	0.00	0.00	0.00	0.00	29.50
	203	8/31/12	0.76	0.24	0.08	0.68	0.00	0.00	0.68	0.68	0.00	0.00	0.00	0.00	0.00	19.10
	203	9/18/12	0.94	0.06	0.02	0.92	0.00	0.00	0.92	0.92	0.00	0.00	0.00	0.00	0.00	34.30
	301	8/31/12	0.70	0.30	0.12	0.58	0.00	0.00	0.58	0.58	0.00	0.00	0.00	0.00	0.00	17.80
	301	9/18/12	1.00	0.00	0.02	0.98	0.00	0.00	0.98	0.98	0.00	0.00	0.00	0.00	0.00	31.50
	402	8/31/12	0.74	0.26	0.02	0.72	0.00	0.00	0.72	0.72	0.00	0.00	0.00	0.00	0.00	17.30
60 seeds/ft2	402	9/18/12	0.88	0.12	0.00	0.88	0.00	0.00	0.88	0.88	0.00	0.00	0.00	0.00	0.00	33.50
Triticale, Red clover Hairy vetch, Radish	104	8/31/12	0.72	0.28	0.16	0.22	0.08	0.26	0.56	0.22	0.00	0.00	0.08	0.00	0.26	9.70
	104	9/18/12	1.00	0.00	0.02	0.54	0.02	0.42	0.98	0.54	0.00	0.00	0.02	0.00	0.42	26.90
	204	8/31/12	0.78	0.22	0.30	0.26	0.02	0.20	0.48	0.26	0.00	0.00	0.02	0.00	0.20	13.70
	204	9/18/12	0.96	0.04	0.06	0.50	0.02	0.38	0.90	0.50	0.00	0.00	0.02	0.00	0.38	34.50
	308	8/31/12	0.72	0.28	0.14	0.36	0.10	0.12	0.58	0.36	0.00	0.00	0.10	0.00	0.12	10.20
	308	9/18/12	0.98	0.02	0.12	0.48	0.02	0.36	0.86	0.48	0.00	0.00	0.02	0.00	0.36	25.90
	404	8/31/12	0.78	0.22	0.12	0.36	0.06	0.24	0.66	0.36	0.00	0.00	0.06	0.02	0.22	16.50
20 seeds/ft2	404	9/18/12	0.96	0.04	0.04	0.36	0.02	0.54	0.92	0.36	0.00	0.00	0.02	0.00	0.54	36.10
Triticale, Red clover Hairy vetch, Radish	105	8/31/12	0.86	0.14	0.06	0.34	0.08	0.38	0.80	0.34	0.00	0.00	0.08	0.00	0.38	15.50
	105	9/18/12	0.96	0.04	0.00	0.54	0.00	0.42	0.96	0.54	0.00	0.00	0.00	0.02	0.40	29.50
	209	8/31/12	0.78	0.22	0.08	0.24	0.08	0.38	0.70	0.24	0.00	0.00	0.08	0.00	0.38	17.80
	209	9/18/12	0.98	0.02	0.02	0.40	0.00	0.56	0.96	0.40	0.00	0.00	0.00	0.00	0.56	40.60
	310	8/31/12	0.78	0.22	0.10	0.36	0.08	0.24	0.68	0.36	0.00	0.00	0.08	0.00	0.24	14.00
	310	9/18/12	0.94	0.06	0.08	0.42	0.00	0.44	0.86	0.42	0.00	0.00	0.00	0.00	0.44	24.40
	407	8/31/12	0.88	0.12	0.10	0.32	0.04	0.42	0.78	0.32	0.00	0.00	0.04	0.00	0.42	18.30
40 seeds/ft2	407	9/18/12	0.98	0.02	0.00	0.40	0.00	0.58	0.98	0.40	0.00	0.00	0.00	0.00	0.58	33.00

Cover Crop Mix	Plot ID	Date	Percentage (1.00=100%)													Plot Height (cm)
			Total Cover	Bare Ground	Weed	Planted Grass	Planted Legume	Planted Forb	Total Planted Cover	Rye/ Triticale	Oat	Clover	Vetch	Rape	Radish	
Triticale, Red clover Hairy vetch, Radish	106	8/31/12	0.92	0.08	0.04	0.44	0.08	0.36	0.88	0.44	0.00	0.00	0.08	0.00	0.36	17.80
	106	9/18/12	1.00	0.00	0.00	0.46	0.00	0.54	1.00	0.46	0.00	0.00	0.00	0.00	0.54	33.00
	201	8/31/12	0.86	0.14	0.06	0.42	0.02	0.36	0.80	0.42	0.00	0.00	0.02	0.00	0.36	15.20
	201	9/18/12	0.90	0.10	0.00	0.32	0.00	0.58	0.90	0.32	0.00	0.00	0.00	0.00	0.58	33.50
	306	8/31/12	0.94	0.06	0.04	0.38	0.02	0.50	0.90	0.38	0.00	0.00	0.02	0.00	0.50	16.80
	306	9/18/12	1.00	0.00	0.00	0.44	0.00	0.56	1.00	0.44	0.00	0.00	0.00	0.00	0.56	29.00
	401	8/31/12	0.76	0.24	0.02	0.42	0.02	0.30	0.74	0.42	0.00	0.00	0.02	0.00	0.30	15.50
60 seeds/ft2	401	9/18/12	0.84	0.16	0.00	0.46	0.00	0.38	0.84	0.46	0.00	0.00	0.00	0.00	0.38	39.60
Triticale, Red clover, Hairy vetch, Radish, Oats, Rapeseed	107	8/31/12	0.72	0.28	0.16	0.34	0.02	0.20	0.56	0.34	0.00	0.00	0.02	0.06	0.14	11.70
	107	9/18/12	1.00	0.00	0.10	0.48	0.04	0.38	0.90	0.48	0.00	0.00	0.04	0.08	0.30	26.40
	202	8/31/12	0.78	0.22	0.28	0.32	0.04	0.14	0.50	0.32	0.00	0.00	0.04	0.00	0.14	15.70
	202	9/18/12	0.88	0.12	0.14	0.42	0.04	0.28	0.74	0.42	0.00	0.00	0.04	0.08	0.20	30.00
	302	8/31/12	0.70	0.30	0.14	0.40	0.04	0.12	0.56	0.40	0.00	0.00	0.04	0.04	0.08	10.70
	302	9/18/12	1.00	0.00	0.04	0.58	0.00	0.38	0.96	0.58	0.00	0.00	0.00	0.16	0.22	31.00
	410	8/31/12	0.64	0.36	0.18	0.32	0.04	0.10	0.46	0.32	0.00	0.00	0.04	0.00	0.10	15.70
20 seeds/ft2	410	9/18/12	0.96	0.04	0.08	0.48	0.00	0.40	0.88	0.48	0.00	0.00	0.00	0.16	0.24	38.10
Triticale, Red clover, Hairy vetch, Radish, Oats, Rapeseed	108	8/31/12	0.74	0.26	0.08	0.38	0.06	0.22	0.66	0.38	0.00	0.00	0.06	0.04	0.18	13.20
	108	9/18/12	1.00	0.00	0.00	0.52	0.02	0.46	1.00	0.52	0.00	0.00	0.02	0.18	0.28	33.50
	208	8/31/12	0.88	0.12	0.10	0.44	0.04	0.30	0.78	0.44	0.00	0.00	0.04	0.02	0.28	17.50
	208	9/18/12	0.98	0.02	0.00	0.56	0.02	0.40	0.98	0.56	0.00	0.00	0.02	0.04	0.36	43.20
	309	8/31/12	0.76	0.24	0.04	0.42	0.00	0.30	0.72	0.42	0.00	0.00	0.00	0.08	0.22	13.20
	309	9/18/12	1.00	0.00	0.04	0.54	0.00	0.42	0.96	0.54	0.00	0.00	0.00	0.10	0.32	27.40
	403	8/31/12	0.82	0.18	0.16	0.42	0.06	0.14	0.66	0.42	0.00	0.00	0.06	0.04	0.10	16.50
40 seeds/ft2	403	9/18/12	0.92	0.08	0.02	0.38	0.06	0.46	0.90	0.38	0.00	0.00	0.06	0.02	0.44	43.20
Triticale, Red clover, Hairy vetch, Radish, Oats, Rapeseed	109	8/31/12	0.84	0.16	0.04	0.44	0.02	0.34	0.80	0.44	0.00	0.00	0.02	0.10	0.24	15.20
	109	9/18/12	0.98	0.02	0.00	0.40	0.00	0.58	0.98	0.40	0.00	0.00	0.00	0.10	0.48	35.10
	206	8/31/12	0.66	0.34	0.08	0.38	0.04	0.16	0.58	0.38	0.00	0.00	0.04	0.04	0.12	13.50
	206	9/18/12	0.82	0.18	0.00	0.50	0.04	0.28	0.82	0.50	0.00	0.00	0.04	0.02	0.26	39.10
	303	8/31/12	0.80	0.20	0.04	0.42	0.02	0.32	0.76	0.42	0.00	0.00	0.02	0.04	0.28	17.30
	303	9/18/12	1.00	0.00	0.02	0.40	0.00	0.58	0.98	0.40	0.00	0.00	0.00	0.10	0.48	38.10
	408	8/31/12	0.92	0.08	0.02	0.54	0.06	0.30	0.90	0.54	0.00	0.00	0.06	0.08	0.22	19.80
60 seeds/ft2	408	9/18/12	0.98	0.02	0.00	0.48	0.04	0.46	0.98	0.48	0.00	0.00	0.04	0.10	0.36	38.60
No Cover Crop	110	8/31/12	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50
	110	9/18/12	0.94	0.06	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.10
	207	8/31/12	0.46	0.54	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50
	207	9/18/12	0.84	0.16	0.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.70
	305	8/31/12	0.42	0.58	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50
	305	9/18/12	0.86	0.14	0.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.60
	406	8/31/12	0.42	0.58	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50
406	9/18/12	0.94	0.06	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.90	

**Table CC-6. Crop biomass and botanical composition**

Sample Date	Mix	Plot	Above ground Dry Matter %	Total Above ground DM lb/acre	Botanical Composition of Aboveground Biomass						Above Ground N %	Radish Root Dry Matter %	Radish Root DM lb/acre	Radish Root %N
					%Weed	%Grass	%Legume	%Rape	%Radish (top)					
09/21/12	220	101	14.2	3404	2.7	97.3	0.0	.	.	5.0	.	.	.	
10/31/13	220	101	21.6	1437	.	100.0	0.0	.	.	2.6	.	.	.	
09/21/12	220	205	15.0	3189	26.3	73.7	0.0	.	.	5.2	.	.	.	
10/31/13	220	205	14.9	2831	.	100.0	0.0	.	.	4.4	.	.	.	
09/21/12	220	307	19.2	3534	13.6	86.4	0.0	.	.	5.0	.	.	.	
10/31/13	220	307	15.3	3309	.	100.0	0.0	.	.	3.3	.	.	.	
09/21/12	220	405	17.9	3826	20.0	80.0	0.0	.	.	4.9	.	.	.	
10/31/13	220	405	12.0	3398	.	100.0	0.0	.	.	4.3	.	.	.	
09/21/12	240	102	15.4	2753	8.1	91.8	0.0	.	.	5.0	.	.	.	
10/31/13	240	102	16.1	2845	.	100.0	0.0	.	.	4.3	.	.	.	
09/21/12	240	210	13.5	3435	1.9	98.1	0.0	.	.	5.0	.	.	.	
10/31/13	240	210	12.3	2716	.	100.0	0.0	.	.	4.4	.	.	.	
09/21/12	240	304	12.1	3503	8.9	91.1	0.0	.	.	4.8	.	.	.	
10/31/13	240	304	13.6	1891	.	100.0	0.0	.	.	4.2	.	.	.	
09/21/12	240	409	16.5	4137	0.1	99.8	0.0	.	.	5.0	.	.	.	
10/31/13	240	409	16.1	3735	.	100.0	0.0	.	.	3.4	.	.	.	
09/21/12	260	103	14.7	4877	2.0	97.9	0.0	.	.	4.8	.	.	.	
10/31/13	260	103	14.7	3298	0.0	100.0	0.0	.	.	4.2	.	.	.	
09/21/12	260	203	14.7	3676	1.4	98.5	0.0	.	.	4.8	.	.	.	
10/31/13	260	203	17.8	2325	.	100.0	0.0	.	.	3.3	.	.	.	
09/21/12	260	301	17.3	3529	1.9	98.1	0.0	.	.	5.4	.	.	.	
10/31/13	*	301	13.3	2818	.	96.9	0.0	.	3.1	4.4	.	0	2.9	
09/21/12	260	402	17.0	3411	2.8	97.1	0.0	.	.	4.9	.	.	.	
10/31/13	260	402	12.6	2584	.	100.0	0.0	.	.	4.7	.	.	.	
09/21/12	420	104	14.6	4877	21.0	31.8	0.7	.	46.5	4.8	8.5	556	4.1	

Sample Date	Mix	Plot	Above ground Dry Matter %	Total Above ground DM lb/acre	Botanical Composition of Aboveground Biomass						Above Ground N %	Radish Root Dry Matter %	Radish Root DM lb/acre	Radish Root %N
					%Weed	%Grass	%Legume	%Rape	%Radish (top)					
10/31/13	420	104	14.8	2312	.	74.3	0.0	.	25.7	4.3	9.3	106	2.3	
09/21/12	420	204	11.9	3386	9.8	51.4	0.0	.	38.7	5.3	8.3	298	3.7	
10/31/13	420	204	14.7	2294	.	89.9	0.0	.	10.1	4.4	4.9	24	2.8	
09/21/12	420	308	17.8	4051	15.0	45.6	2.3	.	37.1	5.5	13.6	323	4.2	
10/31/13	420	308	11.7	2633	.	89.4	0.0	.	10.6	4.8	5.6	22	2.5	
09/21/12	420	404	16.6	2637	14.4	68.4	1.7	.	15.5	5.3	7.7	135	3.8	
10/31/13	420	404	12.0	2475	.	91.9	0.0	.	8.1	4.9	4.3	17	2.4	
09/21/12	440	105	9.1	4352	2.7	33.7	0.1	.	63.5	5.0	10.5	403	4.2	
10/31/13	440	105	14.8	3017	.	82.1	0.0	.	17.9	4.3	10.4	120	2.8	
09/21/12	440	209	9.9	4055	1.5	51.3	1.2	.	46.0	5.9	9.3	187	4.3	
10/31/13	440	209	12.7	3308	.	94.5	0.0	.	5.5	4.5	4.3	17	2.2	
09/21/12	440	310	15.4	3579	3.5	49.1	2.1	.	45.2	5.4	13.3	336	4.1	
10/31/13	440	310	11.8	3035	.	96.3	0.0	.	3.7	4.5	.	0	2.9	
09/21/12	440	407	16.8	3872	5.2	61.4	1.7	.	31.8	5.3	12.3	357	4.1	
10/31/13	440	407	14.7	3626	.	97.3	0.0	.	2.7	3.9	.	0	1.8	
09/21/12	460	106	11.2	4653	2.0	54.6	0.8	.	42.6	5.3	5.6	188	4	
10/31/13	460	106	12.5	2710	.	76.4	0.0	.	23.6	4.8	6.3	22	2.8	
09/21/12	460	201	11.7	4274	7.4	42.4	0.6	.	49.6	5.1	8.9	362	4.3	
10/31/13	460	201	14.4	2999	.	92.3	0.0	.	7.7	4.1	.	0	2.6	
09/21/12	460	306	15.0	4877	0.0	48.4	0.9	.	50.7	5.5	15.2	309	4.6	
10/31/13	460	306	12.2	2940	.	97.1	0.1	.	2.8	4.5	.	0	3.1	
09/21/12	460	401	12.5	4288	0.9	54.4	0.9	.	43.8	5.6	11.1	226	4.4	
10/31/13	460	401	11.0	3041	.	68.7	0.5	.	30.8	4.9	10.1	202	3.4	
09/21/12	620	107	12.2	2813	6.8	64.7	3.0	9.4	16.0	5.3	8.9	242	3.6	
10/31/13	620	107	13.0	3244	.	91.3	0.0	0.0	8.7	5	6.9	19	2.9	
09/21/12	620	202	13.5	4088	7.0	65.5	4.2	4.7	18.7	5.2	7.9	282	4.5	

Sample Date	Mix	Plot	Above ground Dry Matter %	Total Above ground DM lb/acre	Botanical Composition of Aboveground Biomass						Above Ground N %	Radish Root Dry Matter %	Radish Root DM lb/acre	Radish Root %N
					%Weed	%Grass	%Legume	%Rape	%Radish (top)					
10/31/13	620	202	15.2	2557	.	89.7	0.0	0.0	10.3	4.3	4.3	12	2	
09/21/12	620	302	14.5	3435	30.6	68.1	1.3	0.1	0.0	5.5	0.0	0		
10/31/13	620	302	12.5	2676	.	96.3	0.0	0.0	3.7	4.5	1.5	3	1.9	
09/21/12	620	410	12.4	4058	9.7	57.5	2.4	0.8	29.7	5.4	9.1	140	3.7	
10/31/13	620	410	11.5	2610	.	90.7	0.0	0.0	9.3	4.9	9.8	49	2.3	
09/21/12	640	108	11.8	3604	3.4	65.2	1.7	0.0	29.7	5.2	7.6	204	3.9	
10/31/13	640	108	13.7	2287	.	85.4	0.0	0.0	14.6	4.7	5.2	22	3	
09/21/12	640	208	11.1	3920	5.1	51.0	0.7	0.0	43.2	5.3	8.5	476	4.2	
10/31/13	640	208	12.7	2168	.	86.8	0.0	0.0	13.2	4.9	.	0	2.7	
09/21/12	640	309	20.6	4406	5.9	71.2	1.0	4.6	17.2	5.0	16.6	76	4.7	
10/31/13	640	309	13.4	2978	.	97.9	0.0	0.0	2.1	4.1	.	0	2.2	
09/21/12	640	403	14.2	4317	0.8	73.1	1.6	0.0	24.5	5.4	10.4	227	4.4	
10/31/13	640	403	11.6	3095	.	93.2	0.0	0.0	6.8	4.7	.	0	3	
09/21/12	660	109	12.0	3558	0.0	62.4	1.1	10.4	26.2	5.4	7.3	107	4.2	
10/31/13	660	109	13.8	3598	.	94.6	0.0	0.0	5.4	4.2	1.2	3	2.7	
09/21/12	660	206	12.0	4498	1.6	45.5	2.1	10.3	40.4	5.4	11.1	266	4.2	
10/31/13	660	206	13.5	2553	.	84.3	1.0	0.5	14.2	4.4	9.0	47	2.4	
09/21/12	660	303	15.0	4628	0.1	62.3	2.0	9.1	26.6	5.4	12.5	144	4.3	
10/31/13	660	303	11.8	3318	.	100.0	0.0	0.0	0.0	4.4	.	0		
09/21/12	660	408	16.5	3848	1.7	59.0	0.5	8.4	30.4	5.1	14.5	211	4.3	
10/31/13	660	408	13.2	3159	.	97.8	0.0	0.0	2.2	4.2	.	0	2	
09/21/12	1000	110	15.9	1824	100.0	.	.	.	.	4.5	.	.		
10/31/13	1000	110	14.5	1854	.	100.0	.	.	.	5.1	.	.		
09/21/12	1000	207	13.0	3441	100.0	.	.	.	.	5.0	.	.		
10/31/13	1000	207	14.0	2458	.	100.0	.	.	.	5	.	.		
09/21/12	1000	305	15.0	2984	100.0	.	.	.	.	4.6	.	.		

Sample Date	Mix	Plot	Above ground Dry Matter %	Total Above ground DM lb/acre	Botanical Composition of Aboveground Biomass						Above Ground N %	Radish Root Dry Matter %	Radish Root DM lb/acre	Radish Root %N
					%Weed	%Grass	%Legume	%Rape	%Radish (top)					
10/31/13	1000	305	13.1	3510	.	100.0	.	.	.	4	.	.		
09/21/12	1000	406	10.6	2322	100.0	.	.	.	.	4.7	.	.		
10/31/13	1000	406	12.7	1861	.	100.0	.	.	.	5	.	.		

<b>Table CC-7. (2012-ND) Soil chemical properties and soil health</b>					
Sampling Period	Solvita 1 day CO <sub>2</sub> -C ppm	Organic C ppm	Organic N ppm	Organic C:N ppm	Soil Health Calculation <sup>1/</sup>
Cover Crop Planting	36.7	376*	40*	9.6*	11.7*
Cover Crop Termination	33.9	398	62	6.7	15.4

\* Significant at P<0.05

<sup>1/</sup> Soil Health Calculation = Solvita 1 day CO<sub>2</sub>-C/organic C:N ratio plus a weighted Organic C and Organic N

<b>Table CC-8. (2012-ND) Nitrogen, phosphate and potash levels</b>			
Sampling Period	N lb/ac	P lb/ac	K lb/ac
Cover Crop Planting	357*	495*	940*
Cover Crop Termination	264	518	884

\* Significant at P<0.05

<b>Table CC-9. (2012-ND) Inorganic P, organic P and total P</b>			
Sampling Period	Inorganic P lb/ac	Organic P lb/ac	Total P <sup>1/</sup> lb/ac
Cover Crop Planting	489	186*	675
Cover Crop Termination	510	132	642

\* Significant at P<0.05

<sup>1/</sup> Total P = Inorganic P + Organic P

<b>Table CC-10. (2012-ND) Inorganic N, organic N and total N</b>			
Sampling Period	Inorganic N lb/ac	Organic N lb/ac	Total N <sup>1/</sup> lb/ac
Cover Crop Planting	345*	81*	426*
Cover Crop Termination	243	123	366

\* Significant at P<0.05

<sup>1/</sup> Total N = Inorganic N + Organic N

<b>Table CC-11. Seeding rate effects on growth and production of triticale and red clover mix</b>							
Seeding Rate <sup>1/</sup> seeds/ft <sup>2</sup>	Yield DM lb/ac	N content %	N Uptake <sup>2/</sup> lb/ac	Canopy cover 30 day %	Canopy cover 50 day %	Canopy height 30 day %	Canopy height 50 day %
20	3488	5.03	175	42 a <sup>3/</sup>	74 a	12 a	28
40	3457	4.95	171	54 ab	90 b	16 b	31
60	3873	4.98	192	66 b	93 b	18 b	32

<sup>1/</sup> Percent of triticale and red clover in mix are 50 and 50  
<sup>2/</sup> N uptake = DM yield \* N content/100  
<sup>3/</sup> Means within a column followed by the same letters are not significantly different at p<0.05

<b>Table CC-12. Seeding rate effects on growth and production of triticale, red clover, hairy vetch, and radish mix</b>							
Seeding Rate <sup>1/</sup> seeds/ft <sup>2</sup>	Yield DM lb/ac	N content %	N Uptake <sup>2/</sup> lb/ac	Canopy cover 30 day %	Canopy cover 50 day %	Canopy height 30 day %	Canopy height 50 day %
20	3738	5.23	194	57 a <sup>3/</sup>	92	13	31
40	3965	5.40	214	74 b	94	16	32
60	4523	5.38	243	83 b	94	16	34

<sup>1/</sup> Percent of triticale, red clover, hairy vetch and radish in mix are in mix are 45, 23,23, and 10, respectively  
<sup>2/</sup> N uptake = DM yield \* N content/100  
<sup>3/</sup> Means within a column followed by the same letters are not significantly different at p<0.05

<b>Table CC-13. Seeding rate effects on growth and production of triticale, red clover, hairy vetch, radish, oat, rapeseed mix</b>							
Seeding Rate <sup>1/</sup> seeds/ft <sup>2</sup>	Yield DM lb/ac	N content %	N Uptake <sup>2/</sup> lb/ac	Canopy cover 30 day %	Canopy cover 50 day %	Canopy height 30 day %	Canopy height 50 day %
20	3595	5.35	192	52 a <sup>3/</sup>	87	13	31
40	4062	5.23	212	71 b	96	15	37
60	4133	5.33	220	76 b	94	16	38

<sup>1/</sup> Percent of triticale, red clover ,hairy vetch, radish, oat, rapeseed are 23,23,23,23,5,and 5 respectively  
<sup>2/</sup> N uptake = DM yield \* N content/100  
<sup>3/</sup> Means within a column followed by the same letters are not significantly different at p<0.05

**Table CC-14. Contribution of triticale, red clover by seeding rate and weeds to total dry matter yield**

Seeding Rate <sup>1/</sup> seeds/ft <sup>2</sup>	Total DM lb/ac	Triticale lb/ac		Red clover lb/ac		Weed lb/ac	
20	3488	2944 a <sup>2/</sup>	(84%) <sup>3/</sup>	0.75 b	(<1%)	543 b	(16%)
40	3457	3305 a	(96%)	0.71 b	(<1%)	151 b	(4%)
60	3873	3794 a	(98%)	0.70 b	(<1%)	79 b	(2%)

<sup>1/</sup> Percent of triticale and red clover in mix are 50 and 50

<sup>2/</sup> Means within a row followed by the same letter are not significantly different at P<0.05

<sup>3/</sup> Percent of total yield contributed by each vegetation group

**Table CC-15. Contribution of vegetation groups (triticale, red clover, hairy vetch, radish) by seeding rate and weeds to total dry matter yield**

Seeding Rate <sup>1/</sup> seeds/ft <sup>2</sup>	Total DM lb/ac	Grass lb/ac		Legume <sup>2/</sup> lb/ac		Radish lb/ac		Weed lb/ac	
20	3738	1735 a <sup>3/</sup>	(46%) <sup>4/</sup>	43 b	(1%)	1373 a	(37%)	587 b	(16%)
40	3965	1921 a	(48%)	48 b	(1%)	1869 a	(47%)	127 b	(3%)
60	4523	2261 a	(50%)	36 b	(<1%)	2114 a	(47%)	112 b	(2%)

<sup>1/</sup> Percent of triticale, red clover, hairy vetch and radish in mix are in mix are 45, 23,23, and 10, respectively

<sup>2/</sup> Red clover and hairy vetch

<sup>3/</sup> Means within a row followed by the same letters are not significantly different at P< 0.05

<sup>4/</sup> Percent of total yield contributed by each vegetation group

<b>Table CC-16. Contribution of vegetation groups(triticale, red clover, hairy vetch, oat, radish, rapeseed) by seeding rate and weeds to total dry matter yield</b>							
Seeding Rate <sup>1/</sup> seeds/ft2	Total DM lb/ac	Grass lb/ac		Legume <sup>2/</sup> lb/ac	Radish lb/ac	Rapeseed lb/ac	Weed lb/ac
20	3595	2293 a <sup>3/</sup>	(64%) <sup>4/</sup>	99 b (3%)	604 b (17%)	119 b (3%)	481 b (13%)
40	4062	2661 a	(66%)	51 c (1%)	1145 b (28%)	51 c (1%)	154 c (4%)
60	4133	2356 a	(57%)	61 c (1%)	1288 b (32%)	392 c (9%)	36 c (<1%)

<sup>1/</sup> Percent of triticale, red clover, hairy vetch, radish, oat, and rapeseed in mix are 23, 23,23, 23, 5 and 5, respectively  
<sup>2/</sup> Red clover and hairy vetch  
<sup>3/</sup> Means within a row followed by the same letters are not significantly different at P< 0.05  
<sup>4/</sup> Percent of total yield contributed by each vegetation group

<b>Table CC-17. Radish root yield, N content and N uptake in triticale, red clover, and hairy vetch cover crop mix by seeding rate</b>			
Seeding Rate <sup>1/</sup> seeds/ft2	Yield DM lb/ac	N content %	N Uptake <sup>2/</sup> lb/ac
20	328	4.08	14
40	321	4.25	14
60	271	4.23	12

<sup>1/</sup> percent of triticale, red clover, hairy vetch and radish in mix are 45, 23,23, and 10, respectively  
<sup>2/</sup> N uptake = DM yield \* N content/100

<b>Table CC-18. Radish root yield, N content and N uptake in triticale, red clover, hairy vetch, oat, and rapeseed cover crop mix by seeding rate</b>			
Seeding Rate <sup>1/</sup> seeds/ft2	Yield DM lb/ac	N content %	N Uptake <sup>2/</sup> lb/ac
20	187	3.97	7
40	246	4.15	10
60	182	4.33	8

<sup>1/</sup> Percent of triticale, red clover, hairy vetch, radish, oat, and rapeseed are 23,23,23,23,5 and 5 respectively  
<sup>2/</sup> N uptake = DM yield \* N content/100

**Table CC-19. 2013 barley yield**

Mix	Plot	HV Date	Weight (gm)	% Moisture	Calculated dry weight (gm)	Area sampled length (ft)	Area sampled width (ft)	Area sampled (ac)	Dry Yield (lb/ac)	lb/bu-from moisture tester
220	101	08/06/13	453.9	21.9	354.5	17	0.6222222	0.0002428	3216	41.4
220	205	08/06/13	629.3	12.2	552.5	17	0.6222222	0.0002428	5012	43.0
220	307	08/06/13	502.2	8.4	460.0	17	0.6222222	0.0002428	4173	45.6
220	405	08/06/13	568.2	10.8	506.8	17	0.6222222	0.0002428	4597	42.4
240	102	08/06/13	606.8	17.9	498.2	17	0.6222222	0.0002428	4519	43.8
240	210	08/06/13	542.3	12.8	472.9	17	0.6222222	0.0002428	4289	44.5
240	304	08/06/13	887.1	17.1	735.4	17	0.6222222	0.0002428	6671	43.7
240	409	08/06/13	608.5	15.5	514.2	17	0.6222222	0.0002428	4664	45.5
260	103	08/06/13	536.7	11.2	476.6	17	0.6222222	0.0002428	4323	44.5
260	203	08/06/13	633.6	10.5	567.1	17	0.6222222	0.0002428	5144	44.9
260	301	08/06/13	719.2	16.1	603.4	17	0.6222222	0.0002428	5473	43.9
260	402	08/06/13	492.1	11.3	436.5	17	0.6222222	0.0002428	3959	45.2
420	104	08/06/13	942.8	14.0	810.8	17	0.6222222	0.0002428	7355	45.9
420	204	08/06/13	592.0	13.2	513.9	17	0.6222222	0.0002428	4661	44.5
420	308	08/06/13	438.6	7.4	406.1	17	0.6222222	0.0002428	3684	43.7
420	404	08/06/13	389.5	11.0	346.7	17	0.6222222	0.0002428	3144	45.0
440	105	08/06/13	641.0	11.4	567.9	17	0.6222222	0.0002428	5151	47.7
440	209	08/06/13	499.5	12.4	437.6	17	0.6222222	0.0002428	3969	43.8
440	310	08/06/13	445.6	8.1	409.5	17	0.6222222	0.0002428	3714	44.8
440	407	08/06/13	457.6	9.0	416.4	17	0.6222222	0.0002428	3777	43.8
460	106	08/06/13	635.6	11.8	560.6	17	0.6222222	0.0002428	5085	44.1
460	201	08/06/13	527.3	10.5	471.9	17	0.6222222	0.0002428	4281	44.3
460	306	08/06/13	470.9	8.5	430.9	17	0.6222222	0.0002428	3908	45.2
460	401	08/06/13	594.6	10.2	534.0	17	0.6222222	0.0002428	4843	43.5
620	107	08/06/13	606.0	12.1	532.7	17	0.6222222	0.0002428	4832	45.5
620	202	08/06/13	593.2	10.9	528.5	17	0.6222222	0.0002428	4794	45.1
620	302	08/06/13	524.8	9.9	472.8	17	0.6222222	0.0002428	4289	43.5
620	410	08/06/13	599.8	13.4	519.4	17	0.6222222	0.0002428	4712	44.5
640	108	08/06/13	616.6	13.7	532.1	17	0.6222222	0.0002428	4827	44.5
640	208	08/06/13	642.0	10.2	576.5	17	0.6222222	0.0002428	5229	45.4
640	309	08/06/13	543.8	8.3	498.7	17	0.6222222	0.0002428	4523	44.0
640	403	08/06/13	575.5	10.5	515.1	17	0.6222222	0.0002428	4672	44.4
660	109	08/06/13	479.0	10.4	429.2	17	0.6222222	0.0002428	3893	44.5
660	206	08/06/13	486.2	11.2	431.7	17	0.6222222	0.0002428	3916	43.9
660	303	08/06/13	Missing							
660	408	08/06/13	559.2	9.2	507.8	17	0.6222222	0.0002428	4606	46.8
1000	110	08/06/13	407.9	9.4	369.6	17	0.6222222	0.0002428	3352	43.2
1000	207	08/06/13	532.1	11.0	473.6	17	0.6222222	0.0002428	4296	44.3
1000	305	08/06/13	587.4	10.5	525.7	17	0.6222222	0.0002428	4769	44.8
1000	406	08/06/13	540.8	11.7	477.5	17	0.6222222	0.0002428	4331	45.9

**ACTIVE STUDIES: TECHNICAL REPORT 2013**

<b>Study Number</b>	<b>NDPMC-T-1301</b>
<b>Title</b>	<b>Warm-Season Grass Dormant Seeding Trial</b>
<b>Objective</b>	Compare
<b>Duration</b>	2013-2016
<b>Cooperators</b>	USDA, NRCS Plant Materials Center
<b>Location</b>	Bismarck, ND Plant Materials Center
<b>-----Soils</b>	Mandan silt loam
<b>-----MLRA</b>	53B
<b>-----Precip.</b>	2013: 26.75 inches

**Background information:** The influence of seeding date and seedbed cover on warm-season grass establishment in the Northern Great Plains will be evaluated. Warm-season grass establishment has been successful with spring seeding. Dormant and late summer seeding dates have been successful at times, but not consistent.

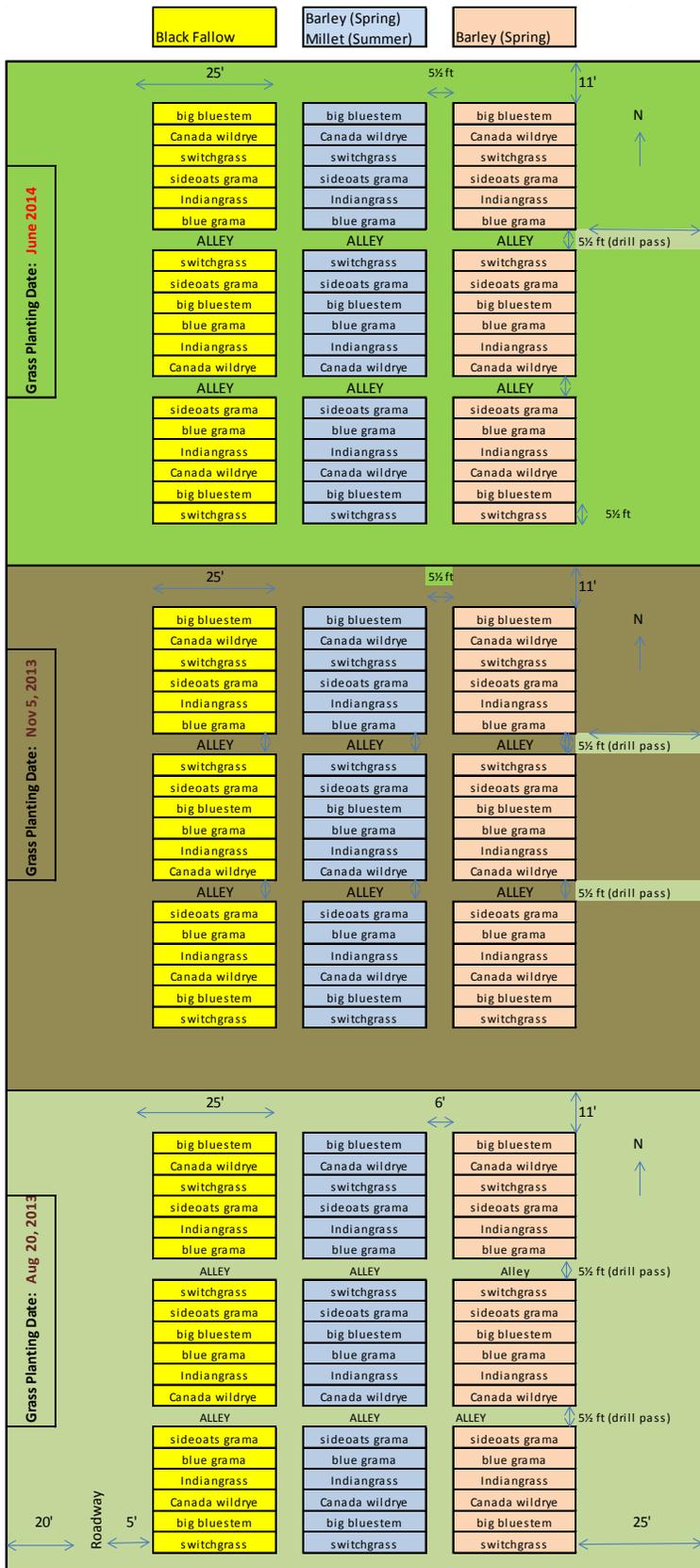
**Methods and Materials:** Five warm-season and one cool-season grass species (*Elymus canadensis*) were planted at three seeding dates into three different seedbed covers. *Elymus canadensis* was used as a check, as it is known to successfully establish as a dormant seeding. The plots were replicated 3 times. The study will be repeated in another field at the PMC in 2014.

<b>Seed Source</b>	
<b>-----Species</b>	5 warm-season species and 1 cool-season species. <i>Andropogon gerardii</i> (big bluestem), <i>Bouteloua curtipendula</i> (sideoats grama), <i>Panicum virgatum</i> (switchgrass), <i>Sorghastrum nutans</i> (Indiangrass), <i>Bouteloua gracilis</i> (blue grama), <i>Elymus canadensis</i> (Canada wildrye)
<b>----Seed Lots</b>	See <b>Table WSG-1</b>
<b>----Seeding Rate</b>	ND Technical Guide Standards X 1.5; See <b>Table WSG-1</b>
<b>----Seeding Dates</b>	<b>Late Summer:</b> August 20, 2013; <b>Dormant:</b> November 5, 2013; <b>Spring:</b> to be seeded May/June 2014
<b>----Seeding Method</b>	No Till Great Plains Drill, through cone, seeding depth was shallow: ¼ - ½ inch.
<b>Seedbeds</b>	See <b>Figure WSG-1</b> for Plot Map
<b>----Barley stubble</b>	Seeded 2-row barley on 5/9/2013 at a seeding rate of 80 lb/ac into cover crop residue from previous year. Seeded with Great Plains drill (through boxes). Combined barley yield 8/6/2013 with M17 combine, Stubble height of 8-10" remaining, Glyphosate applied 8/7/2013 to barley stubble
<b>----Barley stubble + foxtail millet</b>	Foxtail millet seeded 8/8/2013 into barley stubble at a seeding rate of 20 pounds PLS/acre. Seeded with Great Plains Drill (through boxes)
<b>----Black</b>	Site was disked August 1, 2013 and was cultivated and harrowed 4X on August 7, 2013, sprayed with glyphosate
<b>Data Parameters</b>	
<b>----Moisture &amp; Temperature</b>	See <b>Tables WSG-2 and WSG-3</b>
<b>----Stand</b>	2013: no count

**Results and Discussion**

**2013:** There was little or no stand establishment by freeze up. A few very small seedlings of Canada wildrye were found in the black seedbed. Conditions turned dry and cooler after the summer seeding, which may have influenced establishment. There were also very few weeds in any of the seedbeds by freeze up. Temperature, moisture, and stand counts will be recorded in early spring of 2014.

**Figure WSG-1. Plot layout of warm-season grass dormant seeding trial.**



**Table WSG-1. Seed lots**

Species	Variety	Lot	Tech Guide Seeding Rate PLS lb/ac	Seeding Rate Planted (1.5X Tech Guide) PLS lb/ac
big bluestem	Bonilla	SFD-09-D10	6.0	9.00
switchgrass	Forestburg	SFD-07-D11	3.5	5.25
Indiangrass	Tomahawk	SFD-05-E10	5.5	8.25
blue grama	Bad River ecotype	SG2-12-E12	2.0	3.00
sideoats grama	Pierre	SFD-12-E11	6.0	9.00
Canada wildrye	Mandan	SFD-12-D9	6.5	9.75

**Table WSG-2. Soil moisture and soil temperature 8/22/2013**

Sample	Planting Date	Data Collection Date	Bare Ground			Millet/Barley			Barley		
			% moisture	mois-ture	° F temp	% moisture	mois-ture	° F temp	% moisture	mois-ture	° F temp
1	8/21/13	8/22/13	18.1	1.414	70	12.6	1.320	67	6.1	1.209	68
2	8/21/13	8/22/13	10.9	1.292	70	14.8	1.352	68	8.4	1.251	66
3	8/21/13	8/22/13	9.1	1.264	70	9.1	1.261	67	7.8	1.239	68
4	8/21/13	8/22/13	8.5	1.253	70	9.9	1.277	68	9.5	1.270	67
5	8/21/13	8/22/13	7.8	1.241	70	9.5	1.269	67	12.1	1.312	68
6	8/21/13	8/22/13	8.8	1.258	70	8.9	1.261	67	8.5	1.251	68
7	8/21/13	8/22/13	7.4	1.234	70	7.7	1.238	66	13.3	1.327	64
8	8/21/13	8/22/13	9.8	1.275	70	10.5	1.287	69	14.2	1.343	69
9	8/21/13	8/22/13	13.3	1.33	70	9.8	1.276	69	17.1	1.386	68
10	8/21/13	8/22/13	7.8	1.239	70	8.8	1.258	68	14.5	1.346	68
AVERAGE			10.15	1.28	70	10.16	1.2799	67.6	11.15	1.2934	67.4

**Table WSG-3. Soil moisture and soil temperature 11/5/2013**

Sample	Planting Date	Data Collection Date	Bare Ground		Millet/Barley		Barley	
			% moisture	° F temp	% moisture	° F temp	% moisture	° F temp
1r1	8/21/13	11/5/13	21.8	31	24.8	30	28.700	30
2r1	8/21/13	11/5/13	21.3	30	24.7	30	27.800	30
3r1	8/21/13	11/5/13	21.2	30	22.9	30	26.800	30
1r2	8/21/13	11/5/13	17.9	30	21.5	30	27.000	30
2r2	8/21/13	11/5/13	15.9	30	21.8	30	26.900	30
3r3	8/21/13	11/5/13	17.4	30	23	30	27.000	32
1r3	8/21/13	11/5/13	17.5	30	21.8	30	22.700	30
2r3	8/21/13	11/5/13	20.4	30	22.7	30	22.200	30
3r3	8/21/13	11/5/13	17.9	30	21	30	22.900	30
newr1	11/5/13	11/5/13	17.6	30	20.1	30	21.900	30
newr2	11/5/13	11/5/13	20.7	30	26.6	30	22.300	30
newr3	11/5/13	11/5/13	23.1	30	24.3	30	24.200	32
AVERAGE			19.39	30.08	22.93	30.00	25.03	30.33

## **CONSERVATION FIELD TRIALS**

**CONSERVATION FIELD TRIALS: TECHNICAL REPORT 2013**

Number and Title: NDPMC-F-0703-PA Grass/Legume/Forb Demonstration, Wessington Springs, South Dakota

Objective: Compare performance differences among species and varieties of various grasses, forbs, and legumes. The site will be used for education and demonstration and is open for public viewing.

Date Seeded: May 15, 2007

Cooperators: Jerauld County Conservation District and the USDA-NRCS, Wessington Springs, South Dakota

**Figure WS-1. Plot layout of grass/forb demonstration at Wessington Springs, South Dakota, planted 5/15/2007.**



■ blue grama border

Methods and Materials: There are 51 plots of various grasses, legumes, forbs, and mixtures of each. They were seeded with a 6-foot plot drill. The drill consisted of a cone-seeder attachment for each opener so individual rows

were metered separately. Plot size is 12 feet by 48 feet with 16 rows per plot for the grass plots. The forb and selected legumes plots were 28 feet in length and the same width. There are 6-foot borders separating each plot and larger borders on the ends. These areas were seeded to Bad River ecotype blue grama. Two larger plots about 1/2-acre each along the sides of the demonstration area were seeded to an introduced and a native mixture. The south side plot was seeded to an introduced mixture of 35% 'Reliant' intermediate wheatgrass, 35% 'Fleet' meadow brome grass, and 30% 'Travois' alfalfa. The north side plot was seeded to a native mixture of 10 species at 10% each. These included 'Bonilla' big bluestem, Bad River ecotype blue grama, 'Lodorm' green needlegrass, 'Tomahawk' Indiangrass, Badlands ecotype little bluestem, needle-and-thread, 'Goshen' prairie sandreed, 'Pierre' sideoats grama, 'Forestburg' switchgrass, and 'Rodan' western wheatgrass. See Figure WS-1 for plot layout.

**Site Information:** The site was previously planted to alfalfa. The soils are a Lane silty clay loam and the Ecological Site Description is clayey. The site is level. The property is owned by the Jerauld Conservation District and is located on the north edge of Wessington Springs, South Dakota, adjacent to a county highway. The land was sprayed and tilled in 2006. A seedbed was prepared in the spring of 2007 by cultivating, harrowing, and roller packing. Above average rainfall was received in April and May. The plots and borders were mowed twice for weed control during the growing season.

**Table WS-1. Plant performance at the Jerauld County Demonstration Site. In each column the first entry is for 2007, the second is for 2008, the third is for 2009, and the fourth is for 2010. The last column is forage production lbs/ac clipped from a 2' x 10' strip on September 9, 2010 with a forage harvester. Samples are oven-dried weights. Plots with NC were not clipped.**

Common name/Variety (VNS=variety not stated)	(1) Weed Competition	(2) Stand Rating	(3) Vigor	Forage lbs/ac
Crested wheatgrass/AC2	3-2-2-4	4-1-1-3	2-1-1-1	3204
Wheatgrass hybrid/NewHy	2-1-1-2	2-1-1-1	1-1-1-1	3735
Timothy/Climax	6-5-4-5	7-5-4-4	3-2-2-2	2651
Orchardgrass/Latar	5-6-4-5	5-6-4-3	3-3-2-3	1922
Russian wildrye/Mankota	4-3-2-2	4-3-2-2	2-2-2-2	2241
Altai wildrye/VNS	5-6-3-2	3-3-2-1	2-3-2-2	6048
Dahurian wildrye/Arthur	1-1-3-4	2-1-3-4	1-1-3-5	1711
Smooth brome grass/Rebound	2-1-1-1	2-1-1-1	1-1-1-1	5115
Meadow brome grass/Fleet	2-1-1-2	2-1-1-2	1-1-1-1	3721
Intermediate wheatgrass/Reliant	2-1-1-1	2-1-1-1	1-1-1-1	8308
Intermediate wheatgrass/Manifest	3-2-1-1	3-2-1-1	3-1-1-1	7330
Intermediate wheatgrass/Haymaker	2-1-1-1	2-1-1-1	1-1-1-1	6849
Intermediate wheatgrass/Beefmaker	2-1-1-1	2-1-1-1	1-1-1-1	7509
Pubescent wheatgrass/Manska	3-1-1-1	3-1-1-1	2-1-1-1	7741
Tall wheatgrass/Alkar	2-1-1-1	2-1-1-1	3-1-1-1	9113
Prairie junegrass/VNS	8-8-8-8	8-8-8-8	NA	NC
Slender wheatgrass/Pryor	4-4-5-3	4-3-4-3	4-1-3-2	6379
Western wheatgrass/Rodan	3-4-5-5	4-4-4-4	2-2-2-3	2785
Canada wildrye/Icy Blue	3-3-3-3	4-3-3-3	4-2-2-2	4193
Canada wildrye/Mandan	3-2-2-2	2-2-1-2	2-1-1-2	2828
Green needlegrass/Lodorm	3-3-3-2	3-2-2-2	3-1-2-1	4254
Porcupinegrass/VNS	5-8-6-5	6-6-3-4	5-5-3-3	3279
Needle-and-thread/VNS	4-4-6-8	4-3-4-8	4-2-4-NA	NC
Buffalograss/Bowie	2-3-6-7	2-2-2-6	1-1-3-3	2416
Blue grama/Bad River	3-3-6-6	3-2-4-5	3-1-3-4	1882
Little bluestem/Badlands	5-6-4-5	5-6-4-3	4-4-2-4	5328
Sideoats grama/Pierre	3-5-3-3	3-4-3-3	3-2-2-4	2050
Big bluestem/Bonilla	4-4-3-2	4-3-3-2	4-3-2-1	5969
Switchgrass/Forestburg	5-6-3-3	4-5-3-1	5-4-2-1	4801
Indiangrass/Tomahawk	5-6-4-2	5-6-3-2	4-4-3-2	3959

Meadow brome (Fleet)+ alfalfa (Travois)	2-1-2-2	2-1-2-2	2-1-2-2	3923
Intermediate (Reliant) + cicer (Lutana)	2-2-2-2	2-2-2-2	2-2-2-2	5975
Western (Rodan) + green needle (Lodorm) + purple prairieclover (Bismarck)	4-3-2-2	4-2-2-2	4-2-2-2	3959
Sideoats (Pierre) + little blue (Badlands) + purple prairieclover (Bismarck)	4-6-3-3	4-5-3-3	4-4-3-3	NC
Cicer milkvetch/Lutana	4-4-2-2	4-2-1-1	3-3-2-2	5321
Alsike clover/VNS	2-2-8-8	2-2-8-8	2-2-NA-NA	NC
Ladino white clover/VNS	4-3-8-8	4-3-8-8	3-3-NA-NA	NC
Red clover/Kenland	3-2-6-3	2-2-3-2	2-3-3-2	5053
Alfalfa/Travois	2-1-2-4	2-1-1-3	2-1-3-5	4514
Yellow alfalfa/SDSU	3-2-2-2	3-1-1-1	3-1-2-1	5201
Birdsfoot trefoil/Dawn	2-2-2-3	2-1-1-2	2-1-3-3	5391
Sainfoin/Eski	2-2-5-6	3-1-4-6	3-1-6-6	NC
Sideoats (Pierre) + Purple prairieclover (Bismarck)	4-4-4	4-4-3	4-4-3-5*	NC
Sideoats (Pierre) + White prairieclover (Antelope)	4-4-5	4-3-4	4-4-3-5*	NC
Sideoats (Pierre) + Canada milkvetch (9069117)	4-5-6	6-6-5	4-5-3-5*	NC
Sideoats (Pierre) + Illinois bundleflower (MN)	4-5-5	4-5-4	4-5-3-7*	NC
Sideoats (Pierre) + Blue flax (Appar)	4-3-4	4-2-3	4-3-3-7*	NC
Sideoats (Pierre) + Yellow coneflower (Stillwater)	5-3-6	5-3-5	5-3-3-8*	NC
Sideoats (Pierre) + Blanketflower (VNS)	4-3-7	4-4-6	4-3-3-7*	NC
Sideoats (Pierre) + Maximillian sunflower (Medicine Creek)	5-5-4	5-5-4	5-5-3-3*	NC
Sideoats (Pierre) + Stiff sunflower (Bismarck)	4-4-3	4-4-2	4-4-2-4*	NC

(1) 1 = no weeds, 9 = all weeds

(2) 1 = highest, 9 = lowest

(3) 1 = highest, 9 = lowest

\*Forb only rated

### Results and Discussion:

**2007:** The plots were off to a good start after seeding. Evaluation ratings were taken on August 24, 2007, on stand, vigor, and weed competition (see Table WS-1 for performance information). ‘NewHy’ hybrid wheatgrass, ‘Arthur’ Dahurian wildrye, ‘Rebound’ smooth brome grass, Fleet meadow brome grass, ‘Alkar’ tall wheatgrass, ‘Mandan’ Canada wildrye, and all of the intermediate wheatgrass varieties established well and had stand ratings of 2. ‘Bowie’ buffalograss also looked very good and was the only warm-season entry to have an initial stand rating of 2. ‘Climax’ timothy and prairie junegrass did not establish well. Comparing the legumes, alsike clover, ‘Kenland’ red clover, Travois alfalfa, and ‘Dawn’ birdsfoot trefoil were off to a good start and had stand ratings of 2. The forb plantings (with sideoats grama) and the grass/legume mixtures generally had stand ratings of 4 to 6 and were slower to establish. Weed competition and vigor ratings varied considerably across all plots. The larger sized native and introduced mixture plots seeded on the north and south ends, established well.

**2008:** Notes were taken on July 21, 2008. Generally, there was less weed competition and most cool-season entries had higher stand ratings in 2008. The brome grass entries (both smooth and meadow), tall wheatgrass, and pubescent/intermediate wheatgrass varieties had excellent stands and heavy biomass. NewHy hybrid wheatgrass and Arthur Dahurian wildrye performed very well. Canada wildrye had good stands with Mandan rated slightly better in stand and vigor compared to ‘Icy Blue’. The stand of green needlegrass had improved from 2007 to 2008. The plot of Bowie buffalograss was again rated very good. Other warm-season grass species were rated somewhat lower than expected. Bonilla big bluestem had the best stand and Pierre sideoats grama the highest vigor rating.

Travois alfalfa, SDSU yellow alfalfa, ‘Eski’ sainfoin, and Dawn alfalfa performed the best of the legumes. The blanketflower, yellow coneflower, and blue flax were very showy in the spring and were rated good for stands. The sunflowers had the poorest stands of the forbs. Both the larger plot native and introduced mixture seedings performed well and had been mowed.

2009: Notes were taken on September 18, 2009. Generally, the cool-season grasses established most rapidly and had the least weed contamination. Warm-season grass species were slower, but many entries had good stands in 2009. Forb and legume species had the most variability in performance. Some of the species with outstanding performance in 2009 included Fleet meadow bromegrass, NewHy hybrid wheatgrass, Alkar tall wheatgrass, AC2 crested wheatgrass, Rebound smooth bromegrass, all five varieties of pubescent/intermediate wheatgrass, Mandan Canada wildrye, Lodorm green needlegrass, Pierre sideoats grama, Bowie buffalograss, Lutana cicer milkvetch, Travois alfalfa, SDSU yellow-blossom alfalfa, and Dawn birdsfoot trefoil. A few of the poorer performing entries included prairie junegrass, alsike clover, and Ladino white clover. Patches of wild lettuce were scattered throughout the planting. The mixtures were harder to evaluate. Sideoats grama performed fairly well in the mixes and was not so aggressive that it took over the plot. Bad River blue grama worked well seeded as a border between entries. It allowed the observers to walk down the length of every plot without walking into the plot. Consideration will be given next year to sampling forage production in selected plots.

2010: A tour in conjunction with a plant materials training session was held on July 21, 2010. The plots were clipped and rated on September 10, 2010. Contaminated or poor performing plots were not harvested. A flail-knife forage harvester was used to clip a 2' x 10' strip in each plot. Contaminant weeds and other grasses were removed before clipping. NRCS and Conservation District employees helped with the clipping. Grab samples were collected and brought back to the PMC for oven drying. After drying the samples were weighed again to determine dry-down. The samples averaged 30%-40% moisture. Tall wheatgrass had the highest forage production at over 9,000 lbs/ac. The intermediate/pubescent wheatgrass entries were in the 7000-8000 lbs/ac range. Big bluestem had the highest production of the warm-season entries at almost 6,000 lbs/ac. Cicer milkvetch, yellow-blossom alfalfa, and red clover all produced more than 5,000 lbs/ac compared to 4,500 lbs/ac for the alfalfa entry. Some of the shorter life span species were gone. The larger mixture plots on the ends were also clipped. The meadow brome, intermediate wheatgrass, and alfalfa mix produced 5,421 lbs/ac compared to the ten species silty range site mix which produced 7,723 lbs/ac.

2011: Plots were evaluated to determine which of the plots would be terminated due to contamination from other species and weeds, and poor stands. Plots selected for termination were Plots 3 and 4, and plots 7-15. They are to be replanted to the same species in the spring of 2012.

2012: Several plots were clipped on 2/15/12 and tested for forage quality for winter grazing potential. Table WS-2 lists the species that were clipped and analyzed for forage quality. Cicer milkvetch, Russian wildrye, blue grama, Dahurian wildrye, and Fleet meadow brome were highest in crude protein and relative feed value as compared to the other species in the quality sampling. The plots indicated for termination in 2011 were tilled for re-seeding in May 2012. Soil conditions were not very conducive for seeding when the plots were seeded on May 16<sup>th</sup>. The seedbed was extremely chunky and dry due to soil and climatic conditions at the time. The following species (mostly forbs) were planted in the same original plot sites: blanketflower, yellow coneflower, blue flax, Illinois bundleflower, Canada milkvetch, white prairieclover, purple prairieclover, sainfoin, birdsfoot trefoil, timothy, and orchardgrass. Observations in July indicated poor emergence and grasshopper infestations, all due to seedbed conditions and drought across a large area in the southern portion of the Northern Great Plains.

2013: Annual evaluation and data collection by the PMC was finalized in 2012. However, the Conservation District continues to maintain and utilize the herbaceous and woody species plots for their education, demonstration, and evaluation purposes indefinitely. This planting will continue to be an asset and beneficial plant materials resource for all partners and the local community, for as long as these plots are maintained.

**CONSERVATION FIELD TRIALS: TECHNICAL REPORT 2013**

Number and Title: SDPMC-F-1202-PA Aurora County, South Dakota Conservation District Grass/Legume/Forb Demonstration

Objective: Establish a multi-species planting that will be utilized for community educational purposes training to demonstrate performance and utilization potential for conservation needs in the area.

Date Seeded: May 15, 2012

Cooperators: Plankinton, SD NRCS, Aurora County Conservation District, SDSU Extension Service, and Millborn Seeds.

Site Information: Along the south side of old Hwy 16 on the west edge of Plankinton, SD, just west of the Aurora County shop and Conservation District Building. The soils are Houdek-Dudley complex loam/silt loam, moderately drained, mostly level with clay-loam sub-layers. There is evidence of a pre-existing narrow driveway that was covered by a shallow layer of gravel, running east-west across the site. The seeding was done with the plot drill into soils that were left untilled (they were tilled early the previous year followed by chemical weed control the rest of the 2011 growing season). Some spots in the site had soils that were hard for the drill to penetrate, and those areas were hand raked to get adequate seed to soil contact. Figure PL-1 indicates the plot layout of warm and cool-season, native and introduced grasses, legumes and forbs that were established in 2012. Forty separate plots were established, with some species seeded as monocultures and others included in mixes. Species included in the mixes are shown in Table PL-1.

Methods and Materials: There are forty 11-ft x 38-ft plots of individual grasses, and grass/legume mixes with a 16-ft blue grama border in this planting (see Figure PL-1). There is an additional acreage for woody species to be planted on the south side of these plots. Total area of all herbaceous plantings is approximately three acres. The plots for this planting were tilled and chemical fallowed in 2011. They were again treated with glyphosate in the spring of 2012, prior to seeding with the PMC plot drill. There was no tillage done before seeding the plots. The blue grama border was seeded at a later date and that ground was tilled prior to seeding.

**Figure PL-1. Plot layout of grass/legume/forb demonstration at Plankinton, South Dakota (11-ft x 38-ft plots)**

16' Bad River blue grama border				
16' Bad River blue grama border	1	Kootenai timothy	21	Forb Mix #3
	2	Latar orchardgrass	22	Forb Mix #1
	3	Fawn tall fescue	23	SD common alfalfa (purple)
	4	AC Sallander quack X bluebunch	24	MN Native Canada milkvetch
	5	Fleet meadow brome	25	VNS (medium) red clover
	6	Omaha Virginia wildrye	26	Warm Season Mix
	7	Mankota Russian wildrye	27	Tomahawk Indiangrass
	8	Oahe intermediate wheatgrass	28	Bounty big bluestem
	9	Revenue slender wheatgrass	29	Sunnyview big bluestem
	10	Alkar tall wheatgrass	30	Sunburst switchgrass
	11	Lodorm green needlegrass	31	Rodan western wheatgrass
	12	Bonilla big bluestem	32	Manska pubescent wheatgrass
	13	Itasca little bluestem	33	Manifest intermediate wheatgrass
	14	Forestburg switchgrass	34	Mandan Canada wildrye
	15	Pierre sideoats grama	35	PMC Virginia wildrye
	16	VNS white clover	36	Prairieland Altai wildrye
	17	Lutana cicer milkvetch	37	NewHy quack X bluebunch
	18	Don yellow alfalfa	38	Garrison creeping foxtail
	19	Forb Mix #2	39	Pennlate orchardgrass
	20	Cool Season Mix	40	Palaton reed canarygrass
16' Bad River blue grama border				

Tree Plots

**Table PL-1. Mixture components**

Mixes			
Warm-Season Mix		Forb Mix-1	
big bluestem	Bonilla	purple prairieclover	Bismarck
Indiangrass	Holt	white prairieclover	Antelope
switchgrass	Forestburg	yellow coneflower	
little bluestem	Itasca	purple coneflower	
sideoats grama	Pierre	black-eyed susan	
Cool-Season Mix		Forb Mix-2	
meadow brome	Fleet	illinois bundleflower	
pubescent whtgr	Manska	partridge pea	
cicer milkvetch	Lutana	blanketflower	
Forb Mix-3		bergamot	
maximilian sunflower		blue flax	
stiff sunflower		western yarrow	

## Results and Discussion

2012: Plots were evaluated for stand on 7/23/12. Stand ratings and comments are included in Table PL-2. This area experienced a severe drought in 2012, and rainfall was extremely limited from late spring throughout the entire growing season. There was adequate stored soil moisture for most species to germinate and establish well. The timothy, big bluestem, green needlegrass, and several forbs displayed the poorest emergence at this evaluation date. Weeds (pigweed and foxtail) were becoming an issue in several plots, especially the forb mixes on the western side of the site. Weeds were clipped prior to this evaluation, and it was recommended that (other than the forbs plots) they be clipped shorter to keep them from going to seed. There was no evidence of blue grama germination in the borders. The borders were seeded at a later date than the individual plots, and were planted into cultivated soil. For those reasons, it was apparent there was no longer sufficient soil moisture available for good germination, and/or seed may have been planted too deeply in the looser soil.

2013: Plots were evaluated on 6/24/13 for stand and overall appearance. It was seasonally early for evaluating some of the warm-season species that were just getting established. Weed pressure was especially heavy in plots that had poor or slow emergence. The timothy, orchardgrass, Indiangrass, tall fescue, big bluestem, switchgrass, and 'Omaha' Virginia wildrye plots were thin and very weedy as compared to the plots of other grass species and varieties. The PMC Virginia wildrye (under evaluation for future release) looked considerably better than the 'Omaha' variety at this juncture. The wheatgrasses and wheatgrass crosses were well established and competing well with the heavy weed pressure in these plots. Most legumes including the yellow and common alfalfas, and the Canada and cicer milkvetch were establishing well, while the red and white clovers were not. Some forbs in the forb mixes were establishing quite well in spite of the heavy weed pressure. Other forb species were not observed at all in the mixed plots. The cool-season mix was well established. The warm-season mix was fairly well established as compared to the individual plots of those species that are also included in the mix. Table PL-2 provides detailed evaluation information and also indicates plots that are located over an old driveway. Performance of plants is poorer in those portions of the plots that were seeded over that driveway. A general walk-through evaluation was also completed on 9/19/13. It appeared that the plots had not been clipped for weed control during the summer, and there was extremely heavy weed pressure with tall weeds crowding out several of the mixes and warm-season species, especially where stands were thin. It appeared that some of the forbs stands were still improving. Warm-season species plots that were thin in June were still very poorly established in September. It was apparent that some species would need to be reseeded. The Field Office and District will evaluate the site in May 2014 to determine which plots need to be reseeded.

**Table PL-2. Stand evaluation of grass/legume/forb demonstration at Plankinton, South Dakota.**

Plankinton, SD Grasses and Forbs Plot Evaluation (seeded May 15, 2012)							
Plot #	Common Name	Variety	Stand Rating <sup>1</sup>		7/23/12 Comments	6/24/13 Comments	
			7/23/12	6/24/13			
1	timothy	Fleet	9	9	Plots were very dry and very weedy with pigweed and some yellow/green foxtail.	no plants visible	
2	orchardgrass	Latar	4	8		poor stand; very weedy	
3	tall fescue	Fawn	3	7		poor stand; very weedy	
4	quack x bluebunch	AC Saltlander	2	1		excellent	
5	meadow brome	Fleet	2	1	Some diseased leaves	excellent	
6	Virginia wildrye	Omaha	4	8	Recommended clipping weeds shorter and coming back with an application of Banvel in late May 2013 to control weeds in grasses.	poor stand; very weedy	
7	Russian wildrye	Mankota	2	2		good	
8	intermed. wheatgrass	Oahe	2	2		good	
9	slender wheatgrass	Revenue	3	5		mediocre stand; weedy	
10	tall wheatgrass	Alkar	2	1		excellent	
11	green needlegrass	Lodorm	5	3		good stand; weedy	
12	big bluestem	Bonilla	4	8		poor stand; weedy	May be too early in the season for good evaluation
13	little bluestem	Itasca	5	9		no stand; weedy	
14	switchgrass	Forestburg	5	7		poor stand; weedy	good evaluation
15	sideoats grama	Pierre	3	1		good stand; weedy	
16	white clover	VNS	4	7		poor stand; weedy	
17	cicer milkvetch	Lutana	5	3		fairly good stand; weedy	
18	yellow alfalfa	Don	5	2		good stand; somewhat weedy	
19	Forb Mix #2		3	2		good stand of most species; weedy	
20	Cool Season Mix		3	1		excellent	
21	Forb Mix #3		9	6	both species visible; weedy		
22	Forb Mix #1		3	7	Some seedlings dried out	3 species observed; weedy	
23	alfalfa (purple)	SD Common	3	2		somewhat weedy	
24	Canada milkvetch	MN Native	6	2-9		fair stand; weedy	Portions of these plots are negatively impacted by what appears to be an old driveway
25	red clover	VNS(medium)	4	2-9		fair stand; weedy	
26	Warm Season Mix		4	4		fair stand; weedy	
27	Indiangrass	Tomahawk	4	8		poor stand; weedy	
28	big bluestem	Bounty	5	6-9		fair-poor stand; weedy	
29	big bluestem	Sunnyview	8	7		mediocre stand; weedy	
30	switchgrass	Sunburst	5	7		mediocre stand; weedy	
31	western wheatgrass	Rodan	4	1	Some seedlings dried out	Good stand; somewhat weedy	
32	pubescent wheatgrass	Manska	3	1		excellent	
33	intermed. wheatgrass	Manifest	3	2		excellent	
34	Canada wildrye	Mandan	3	3		mostly good stand; somewhat weedy	
35	Virginia wildrye	PMC	3	2		vigorous; some weeds	
36	Altai wildrye	Prairieland	3	2		good stand; some weeds	
37	quack X bluebunch	NewHy	2	1		excellent	
38	creeping foxtail	Garrison	5	1	Some seedlings dried out	excellent	
39	orchardgrass	Pennlate	2	2		excellent	
40	reed canarygrass	Palaton	4	1		excellent	
Borders- blue grama		Bad River	9		Planted late-poor	will be reseeded	

<sup>1</sup> Stand ratings: 1 = highest, 9 = lowest

**CONSERVATION FIELD TRIALS: TECHNICAL REPORT 2013**

Number and Title: NDPMC-F-1103-PA Sully County, South Dakota Conservation District Grasses and Forbs Demonstration

Objective: Provide a living demonstration site to evaluate the forage potential of different grass and forb species

Date Seeded: June 7, 2011

Cooperators: Sully County Conservation District and Fair Board

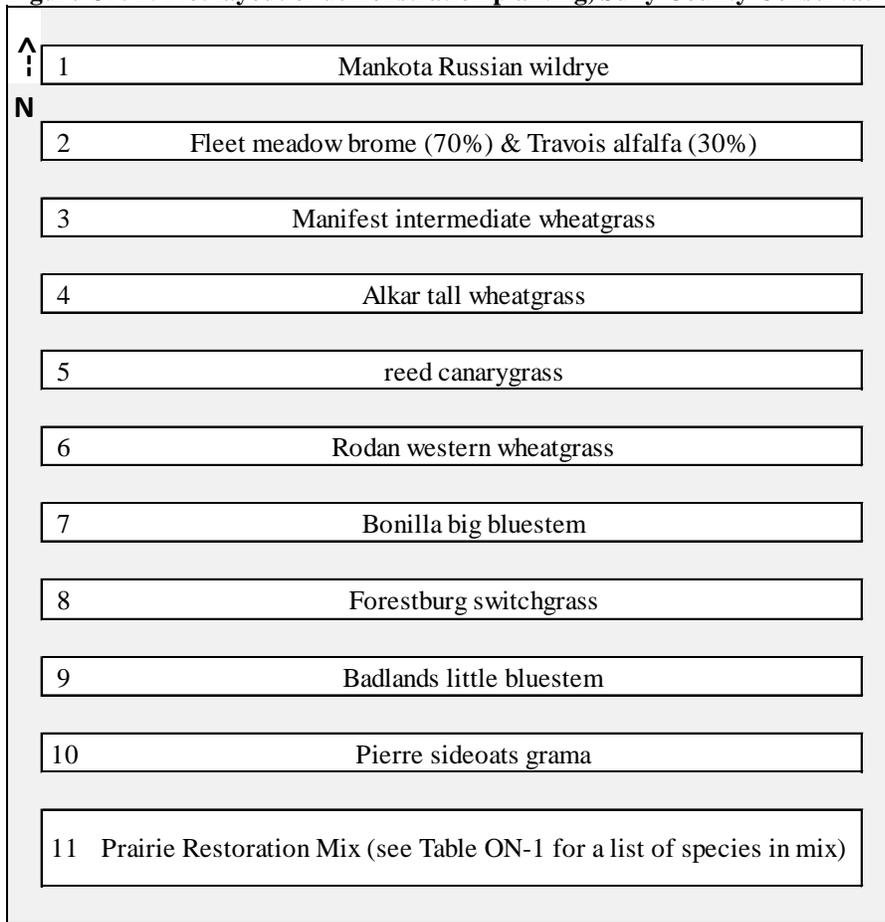
Methods and Materials: This planting includes 9 single species grass plots, one grass-legume plot, and one prairie restoration plot (see Figure ON-1). The plots were tilled and roller-packed prior to seeding with the PMC 5.5-foot plot drill. The drill consisted of a cone-seeder attachment for each opener, so individual rows were metered separately. Individual plots are 11 feet wide and 20 feet long with 16 rows per plot. The prairie restoration plot is 20 feet wide and 20 feet long with 32 rows seeded. There is a 5.5-foot blue grama border between each plot and a minimum 10-foot border around the entire planting. The border areas were seeded to Bad River blue grama. All species were seeded at 1½ times the recommended seeding rates.

Site Information: The planting is located on the eastern end of the Sully County Conservation District property at the eastern edge of the city of Onida, SD. It is bordered by tree windbreaks on the east and south. It is adjacent to the county fairgrounds which borders this site on the north. The site was previously in grass until the spring /summer of 2010, when it was chemically fallowed with glyphosate to kill existing vegetation. In the fall of 2010 the chemical fallowed area was tilled in preparation for seeding in the spring of 2011. The soils are Onida silt loam complex and the site is level.

**Table ON-1. List of species included in the prairie restoration mix in the demonstration planting, Sully County SCD, South Dakota**

Grasses Included in the Prairie Restoration Mix	Forbs/Wildflowers Included in the Prairie Restoration Mix
Bad River Ecotype blue grama	Echinacea
'Bonilla' big bluestem	purple prairieclover
'Lodorm' green needlegrass	blanketflower
'Tomahawk' Indiangrass	yellow coneflower
Badlands Ecotype little bluestem	leadplant
needleandthread	shell-leaved penstemon
prairie junegrass	stiff sunflower
prairie sandreed	yarrow
'Pierre' sideoats grama	dotted gayfeather
'Mandan' Canada wildrye	Canada milkvetch
'Rodan' western wheatgrass	black-eyed susan
	false sunflower
	Maximilian sunflower

**Figure ON-1. Plot layout of demonstration planting, Sully County Conservation District, SD**



**Results and Discussion:**

**2011:** Above average rainfall and a cool spring delayed planting until June 7. The soils were still saturated at planting and a few plots were almost too wet to plant. Heavy rainfall events during the summer of 2011 resulted in flooding on portions of the plots on the northern end of the site. Much of the flooding was a result of some minor diking on the driveway on the north side of the site. This concern was later remediated by the District and is no longer an issue. No further evaluation was done in 2011. A spring, 2012 evaluation will be completed to determine which species might need to be replanted as a result of the flooding.

**2012:** The site was evaluated by the District Conservationist on 4/1/12. Portions of plots 1, 2, and 3 were dead and bare as a result of 2011 flooding. Some of the blue grama border on the northern part of the site was also dead as a result of flooding. The bare areas of plots 1, 2, and 3 were tilled, packed and reseeded to original species and rates on May 16. The plots were evaluated again on July 23 (see Table ON-2). Most species that were not impacted by flooding appeared to be establishing well. The big and little bluestem plots were very thin and weedy, and the brome/alfalfa plot that was reseeded had very poor emergence and was very weedy. The prairie restoration plot was well-established and relatively weed-free. Some weeding was done during this evaluation, and District personnel will spray the grass plots that have the most serious broadleaf weed issues.

**2013:** The plots were evaluated on June 28, 2013 after the area received above-normal rainfall in May and June. All of the grasses and forbs appeared to be vigorous and exhibited very good growth (see Table ON-2). Most species were well established with good plant population. The little and big bluestem plots had thinner stands, but they were still adequate to provide ample forage and compete with the few weeds that were present. Foxtail barley, pigeongrass, and kochia were the most prevalent weeds, but infestations were light and scattered with no impact on performance. Portions of plots 1, 2, and 3 that were reseeded in 2012 due to flood damage were establishing well. Most of the forb species were visible and many were flowering in the prairie restoration plot. Portions of the blue grama border that flooded in 2011 were not reseeded as of this date. Those areas had the most significant weed

pressure. A few plants of smooth brome were also evident in some of the plots. District employees were planning to mow the border in the near future, and repair or replace some of the ID markers that were missing or destroyed. This planting is well established and in prime condition for demonstration/education purposes in the community.

**Table ON-2. Evaluation of demonstration plots on 7/23/2012 at Sully County SCD, South Dakota**

N	Onida, SD Grass Plots Evaluation (1=best; 9=poorest)	7/23/2012			6/28/2013	
		Stand	Weeds	comments	Stand	Weeds
1	Mankota Russian wildrye	2	3	Flood damage	1	2
2	Fleet meadow brome-70% & Travois Alfalfa-30%	7	8	Flood damage	3	4
3	Manifest intermediate wheatgrass	2	1	Flood damage	1	1
4	Alkar tall wheatgrass	1	1	considerable lodging	1	1
5	Reed canarygrass	1	1		1	1
6	Rodan western wheatgrass	1	1		1	1
7	Bonilla big bluestem	4	4		3	2
8	Forestburg switchgrass	3	3		2	2
9	Badlands little bluestem	5	5		3	3
10	Pierre sideoats grama	2	1		2	1
11	Prairie Restoration Mix	1	1		1	1

\*Stand: 1=best, 9=poorest

\*\*Weeds: 1=low weed population, 9=high weed population

**CONSERVATION FIELD TRIALS: TECHNICAL REPORT 2013**

Number and Title: NDPMC-F-1309-DE Marshall County, Minnesota Grasses and Forbs Demonstration

Objective: Provide a living demonstration site to evaluate the conservation potential of different grass and forb species, and conservation program mixes.

Date Seeded: June 18-19, 2013

Cooperators: Marshall County Conservation District and Marshall County Fair Board

Methods and Materials: This planting includes 19 single species grass plots, one single forb plot, 5 plots of different NRCS program conservation mixes, and two forb pollinator mixes. Table WA-1 lists the species of grasses and/or forbs for the single species plots and the plots with different program mixes. Seed was provided by Carlson Seed Farm, Marshall County Conservation District, and the Bismarck PMC. The plots were seeded with a 5.5-ft double disc plot drill with depth bands on the openers. All species were seeded at 1½ times the recommended seeding rates. Individual plots are 11 feet wide and 50 feet long or 22 feet wide and 50 feet long. The borders were seeded to blue grama as indicated in Figure WA-1.

Site Information: Warren is located in the northwestern corner of Minnesota and on the eastern edge of the Red River Valley. The plots are located on the south side of the Marshall County Fairgrounds property which is located in the northeastern edge of the city, north of Highway 1. The plots are separated from the rest of the fairgrounds by a field windbreak, and the conservation district has a new planting of several rows of trees on the west side of this demonstration site. The soils are mostly Fargo clay with very little slope. The plots area was cropped with soybeans in 2012. It was cultivated after harvest with a field cultivator and received heavy snow cover during the winter months. The area received substantial rainfall moisture in the spring of 2013, and planting was delayed until rains subsided long enough to allow for dry seeding conditions. There was very little herbaceous growth prior to seeding, and the ground was packed with a field rolled prior to seeding. No herbicides were applied in 2013.

**Figure WA-1. Plot layout of demonstration planting, Marshall County Conservation District, MN**

Marshall County Grasses/Forbs Demonstration Plots		
←--North		
Site is 186' X 214' (.914 acres) plots = 11' or 22' x 50'		
<i>16' Bad River blue grama borders &amp; lanes</i>		
1. Itasca little bluestem	15. Tomahawk Indiangrass	29. timothy
2. Itasca little bluestem	16. PMC Indiangrass	30. timothy
3. Forestburg switchgrass	17. CP1	31. orchardgrass
4. Dacotah switchgrass	18. CP1	32. orchardgrass
5. Forb Mix 1	19. CP2	33. meadow brome
6. Forb Mix 1	20. CP2	34. meadow brome
7. Pollinator Mix	21. CP21	35. tall fescue
8. Pollinator Mix	22. CP21	36. tall fescue
9. Manifest intermediate wheatgrass	23. CP23	37. PMC Virginia wildrye
10. Manksa pubescent wheatgrass	24. CP23	38. Mandan Canada wildrye
11. Revenue slender wheatgrass	25. CP25	39. western wheatgrass
12. leadplant	26. CP25	40. western wheatgrass
13. Pierre sideoats grama	27. Bison big bluestem	41. Alkar tall wheatgrass
14. Pierre sideoats grama	28. Bounty big bluestem	42. Alkar tall wheatgrass

**Table WA-1. List of species by mixture planted at demonstration planting, Marshall County Conservation District, MN**

Single varieties/species plots		Pollinator Mix		CP 25 Mix	
Bad River	blue grama border	VNS	big bluestem	VNS	Indiangrass
Itasca	little bluestem	VNS	little bluestem	VNS	big bluestem
Forestburg	switchgrass	VNS	Indiangrass	VNS	switchgrass
Dacotah	switchgrass	VNS	Canada wildrye	VNS	sideoats grama
Manifest	intermed whtgrass	VNS	sideoats grama	VNS	slender wheatgrass
Manska	pubescent whtgrass	VNS	wild bergamot	VNS	western wheatgrass
Revenue	slender wheatgrass	VNS	golden alexanders	VNS	little bluestem
PMC	leadplant	VNS	stiff goldenrod	VNS	purple prairieclover
Pierre	sideoats grama	VNS	purple prairieclover	VNS	black-eyed susan
Pierre	sideoats grama	VNS	black-eyed susan	VNS	common oxeye
Tomahawk	Indiangrass	VNS	evening primrose	VNS	Maximilian sunflower
PMC	Indiangrass	VNS	Maximilian sunflower	VNS	white prairieclover
Bison	big bluestem	VNS	white prairieclover	VNS	yellow coneflower
Bounty	big bluestem	VNS	yellow coneflower	VNS	hoary vervain
Climax	timothy	VNS	showy goldenrod	VNS	Canada milkvetch
Potomac or Orion	orchardgrass	VNS	Canada milkvetch	VNS	yarrow
Fleet	meadow brome	VNS	smooth aster	VNS	prairie cinquefoil
Courtenay/select	tall fescue	<b>CP 21 Mix</b>		VNS	wild bergamont
PMC	Virginia wildrye	Mandan	Canada wildrye	<b>CP 23A Mix</b>	
Mandan	Canada wildrye	Rodan	western wheatgrass	Tomahawk	Indiangrass
Rodan	western wheatgrass	Dacotah	switchgrass	Bison	big bluestem
Alkar	tall wheatgrass	Pierre	sideoats grama	Dacotah	switchgrass
<b>CP 2 Mix</b>		<b>CP Mix 1</b>		Red River	prairie cordgrass
Tomahawk	Indiangrass	VNS	orchardgrass	Mandan	Canada wildrye
Bison	big bluestem	VNS	timothy	Rodan	western wheatgrass
Dacotah	switchgrass	Manifest	intermed wheatgrass	Bismarck Germ	purple coneflower
Mandan	Canada wildrye	Travois	alfalfa	VNS	blackeyed susan
Bismarck Germ	purple prairieclover	VNS	red clover	VNS	yarrow
VNS	black-eyed susan	VNS	white clover	VNS	yellow coneflower
VNS	white prairieclover	VNS	alsike clover		
VNS	yarrow				

Results and Discussion:

**2013:** Above average rainfall and a cool, wet spring delayed planting until June 18-19. The soils were still saturated at planting and a few plots were almost too wet to plant. Cool-season species were emerging 2-3 weeks after seeding and looked good. Other vegetative cover included pigweed and volunteer soybeans. These were mowed off in mid-July. There was no further evaluation on this planting for 2013. A spring/summer 2014 evaluation will be completed to determine establishment success of warm-season species.

## **SEED PRODUCTION**

## SEED PRODUCTION RECORD

**Accession:** 'Bison' (NDG-4, 9005667, PI-477994)

**Name/Species:** big bluestem, *Andropogon gerardii*

**Location:** Field E-8

**Year of Establishment:** 1997

**Origin/Source:** Oliver County, North Dakota; USDA, ARS, Mandan, North Dakota

Prod. Year	Seed Class	App./Cert. No.	Seed Lab No.	Bulk (lbs)							Other			Notes
				Acres	Quantity	Purity	Germ.	Dorm.	Inert	Weed	Crop	Test Date		
1998	Foundation	980067-1	9808345	3.04	248.0	95.60	87	0	4.26	0.14	0.00	3/24/1999		
1999	Foundation	990863-1	9904487	1.76	279.5	90.13	90	0	9.86	0.01	0.00	1/26/2000		
1999	Foundation	990863-1	9903569	1.28	165.0	93.62	88	0	6.35	0.03	0.00	1/12/2000	Plateau	
2000	Foundation	201150-1	2007607	3.04	294.0	95.89	90	1	3.95	0.16	0.00	3/13/2001		
2001	Foundation	S0113839	2107325	3.04	419.0	96.95	86	0	2.98	0.07	0.00	3/27/2002		
2002	Foundation	S0210299	L2210878	3.04	115.0	88.48	30	49	11.51	0.01	0.00	4/10/2003		
2003	Foundation	C54832	L2304932	3.04	328.0	93.90	28	57	6.10	0.00	0.00	2/3/2004		
2004	Foundation	S0412038	L2411492	3.00	446.0	96.61	55	37	3.38	0.01	0.00	4/15/2005		
2005	Foundation	S0513080	L2509594	3.00	462.0	96.40	47	42	3.60	0.00	0.00	3/20/2006		
2006	Foundation	S0611773	L2609510	3.00	26.0	69.03	47	38	30.95	0.01	0.01	3/28/2007		
2007	Foundation	C69301	L2703199	3.00	724.0	97.63	42	46	2.33	0.03	0.01	12/13/2007		
2008	Foundation	C81842	L2808793	3.00	270.0	95.71	62	26	4.29	0.00	0.00	4/16/2009		
2009	Foundation	C92149	L2910722	3.00	335.0	87.73	40	45	12.27	0.00	0.00	4/23/2010		
2010	Foundation	C12097	L1008984	2.80	50.0	94.22	61	22	5.62	0.15	0.01	4/21/2011	ergot 0.23%	
2011	Foundation	C21794	L1104759	2.80	399.0	92.34	49	44	7.63	0.03	0.00	12/12/2012	ergot 0.1%	
2012	Foundation	C26199	L1208309	2.80	269.0	98.06	55	43	1.90	0.04	0.00	4/23/2013		
2013	Foundation	C94128	L1308062	2.80	842.0	98.05	38	30	1.91	0.04	0.00	4/17/2014	milkweed	

## SEED PRODUCTION RECORD

**Accession:** 'Bonilla' (SD-27, PI-315658)

**Name/Species:** big bluestem, *Andropogon gerardii*

**Location:** Field D-10

**Year of Establishment:** 1987

**Origin/Source:** Morton County; USDA, ARS, Mandan, North Dakota

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs)</u>			<u>Other</u>			<u>Test Date</u>	<u>Notes</u>	
					<u>Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Crop</u>		
1988	Foundation	1764	M35857	1.40	320.0	97.04	74	1	2.96	0.00	0.00	3/27/1989	
1989	Foundation	91992	N10095	1.40	159.0	95.33	76	0	4.66	0.00	0.01	12/15/1989	
1990	Foundation	1650	N2322	1.40	115.0	98.07	83	1	1.92	0.00	0.01	1/17/1991	
1991	Foundation	2135	N18291	1.40	118.0	93.76	77	0	6.24	0.00	0.00	1/27/1992	
1992	Foundation	1053-1	P08550	1.42	175.0	92.16	73	0	7.83	0.00	0.00	1/12/1993	
1993	Foundation	3067-1	9303772	1.42	165.0	95.07	72	0	4.93	0.00	0.00	2/28/1994	
1994	Foundation	940232-1	9406903	1.42	276.5	93.34	82	1	6.64	0.00	0.02	1/31/1995	
1995	Foundation	950194-1	9514495	1.42	124.5	97.35	89	0	2.64	0.01	0.00	4/22/1996	
1996	Foundation	960049-1	9609264	1.42	242.0	85.85	78	0	14.14	0.01	0.00	3/18/1997	
1997	Foundation	970037-1	9709197	1.42	180.5	92.18	83	1	7.82	0.00	0.00	3/13/1998	
1998	Foundation	980059-1	9803403	1.42	298.0	97.22	88	1	2.78	0.00	0.00	1/5/1999	
1999	Foundation	990858-1	9910452	1.42	237.5	94.58	87	0	5.42	0.00	0.00	4/27/2000	
2000	Foundation	201151-1	2011941	1.42	168.0	89.14	92	0	10.84	0.01	0.01	5/4/2001	
2001	Foundation	S0113838	2106047	1.42	49.0	92.78	88	0	6.75	0.46	0.01	2/26/2002	
2002	Foundation	S0210303	L2213179	1.42	71.0	95.5	70	16	4.48	0.01	0.01	5/7/2003	
2003	Foundation	C5660	L2311320	1.42	200.0	93.26	73	19	6.74	0.00	0.00	4/22/2004	
2004	Foundation	S0412037	L2413895	1.40	198.0	94.75	79	14	5.25	0.00	0.00	5/6/2005	
2005	Foundation	S0513081	L2513292	1.40	258.0	97.87	72	15	2.13	0.00	0.00	5/4/2006	
2006	minimal harvest	S0611774	no test	1.40	0.0								
2007	Foundation	C70557	L2708118	1.40	242.0	97.66	78	8	2.34	0.00	0.00	3/11/2008	
2008	Foundation	C81097	L2806016	1.40	274.0	98.23	84	9	1.76	0.00	0.00	2/1/2009	
2009	Foundation	C91516	L2907228	1.40	235.0	96.25	72	18	3.62	0.13	0.00	3/18/2010	
2010	Foundation	C10993	L1005406	1.40	150.0	96.6	78	9	3.37	0.01	0.01	2/8/2011	ergot 0.25%
2011	Foundation	C23752	L1111639	1.50	215.0	94.76	72	6	5.19	0.04	0.01	7/17/2012	
2012	Foundation	C25988	L1207474	1.40	175.0	96.13	69	15	3.86	0.01	0.00	4/9/2013	ergot 0.63%
2013	Seed not cleaned yet												

**SEED PRODUCTION RECORD****Accession:** Bounty Germplasm**Name/Species:** big bluestem; *Andropogon gerardii***Location:** D11**Year of Establishment:** 2010**Origin/Source:** composite; Minnesota

<b>Prod.</b>		<b>App./Cert.</b>	<b>Seed</b>		<b>Bulk (lbs)</b>						<b>Other</b>	
<u>Year</u>	<u>Seed Class</u>	<u>No.</u>	<u>Lab No.</u>	<u>Acres</u>	<u>Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Crop</u>	<u>Test Date</u>
2010	Breeder	no harvest										
2011	Breeder		L1110933	0.5	80	93.73	45	41	6.23	0.04	0.00	4/27/2012
2012	Select	C25253	L1204953	0.5	27	96.52	26	31	3.48	0.00	0.00	2/11/2013
2013	Select	C28583	L1302799	0.5	83	99.2	5	39	0.8	0.00	0.00	12/18/2013 low germ

**SEED PRODUCTION RECORD**

**Accession:** 9082680

**Name/Species:** fourwing saltbush, *Atriplex canescens*

**Location:** Field D10 (deer fence)

**Year of Establishment:**

**Origin/Source:** Cottonwood, South Dakota

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs) Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Other Crop</u>	<u>Test Date</u>
2002	breeder		no test		5.5		78(TZ)	0	1.4	0.00	0.00	11/13/2002
2003	breeder				3.5	98.6	46	9(hard)	1.4	0.00	0.00	3/3/2004
2004	breeder		no test		6.0							
2005	breeder		no test	100-ft row	0.5							
2006	breeder		no test		20.0							
2007	breeder	bulked with previous years' crop			5.0							
2008	breeder		no test		20.0							
2009	breeder		no test		32.0							
2010	breeder		no test		7.0							
2011	breeder		L1104382		16.0	96.88	4	67	3.12	0.00	0.00	12/28/2011
2012	breeder		no test		9.0							
2013	breeder		no test		21.0							

## SEED PRODUCTION RECORD

**Accession:** Pierre (SD-251, PI-476980)

**Name/Species:** sideoats grama, *Bouteloua curtipendula*

**Location:** Field E-9

**Year of Establishment:** 1977

**Origin/Source:** Stanley County; Ft. Pierre, South Dakota

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs) Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Other Crop</u>	<u>Test Date</u>
1978	Common		H20314	2.40	24.0	89.45	63		10.54		0.01	5/1/1979
1979	Common		I7089	2.40	899.0	88.58	76		11.41	0.01		4/18/1980
1980	Foundation	1020	J7932	1.00	125.0	96.36	69		3.63	0.01		5/11/1981
1981	Foundation	1177	J20193	1.00	346.0	96.74	80		3.24	0.01	0.01	3/25/1982
1982	Foundation	1160	J36814	1.00	344.0	97.43	56		2.55	0.01	0.01	3/24/1983
1983	Foundation	1498	K11299	1.00	520.0	97.85	82	1	2.13	0.01	0.01	4/12/1984
1984	Foundation	1643	K27724	1.00	248.0	98.78	88		1.20	0.01	0.01	4/15/1985
1985					No harvest							
1986	Common		L22863	1.00	123.0	98.77	87	1	1.23	0.00	0.00	3/24/1987
1987	Foundation	16797	M16481	1.00	192.0	93.11	64	1	6.89	0.00	0.00	4/20/1988
1988	Foundation	1777	M29887	1.00	218.0	97.8	77	1	2.18	0.02	0.00	1/3/1989
1989	Foundation	92011	N11668	0.90	129.0	99.34	61	0	0.66	0.00	0.00	1/17/1990
1990	Foundation	1666	N8366	1.10	572.0	98.06	92	0	1.93	0.01	0.00	4/16/1991
1991	Foundation	2143	N20087	1.10	273.5	97.85	80	0	2.13	0.02	0.00	2/28/1992
1992	Foundation	1049-1	P09603	1.10	229.0	93.28	83	0	6.70	0.00	0.02	2/4/1993
1993	Foundation	3062-1	9308492	1.10	113.0	94.19	71	0	5.81	0.00	0.00	4/27/1994
1994	Foundation	940238-1	9411461	1.09	100.0	96.57	68	0	3.43	0.00	0.00	3/21/1995
1995	Foundation	950191-1	9508544	1.09	234.5	97.69	75	0	2.29	0.02	0.00	2/21/1996
1996	Foundation	960044-1	9607307	1.09	186.0	98.43	81	0	1.57	0.00	0.00	2/20/1997
1997	Foundation	970044-1	9711274	1.09	92.5	90.16	88	0	9.84	0.00	0.00	3/19/1998
1998	Foundation	980056-1	9809152	1.09	174.5	96.45	85	0	3.55	0.00	0.00	3/30/1999
1999	Foundation	990860-1	990860-1	1.09	218.5	93.00	81	4	6.96	0.02	0.02	12/14/1999
2000	Foundation	201154-1	2002097	1.09	282.5	98.13	61	24	1.72	0.13	0.02	11/22/2000
2001	Foundation	S0113834	2103684	1.09	288.0	98.30	77	6	1.65	0.00	0.05	12/27/2001
2002	Foundation	S0210298	L2208214	1.09	200.0	95.51	82	0	4.47	0.02	0.00	2/28/2003
2003	Foundation	C56260	L2310165	1.09	157.0	93.95	75	11	6.03	0.02	0.00	4/7/2004
2004	Foundation	S0412041	L2410470	1.10	159.0	98.79	91	0	1.11	0.08	0.02	3/30/2005
2005	Foundation	S0513077	L2507111	1.10	170.0	98.95	87	1	1.03	0.02	0.00	2/14/2006
2006	Foundation	S0611782	L2602844	1.10	115.0	96.82	30	37	3.16	0.02	0.00	12/4/2006
2007	Foundation	C69026	L2702396	1.1	236.0	96.13	35	60	3.83	0.02	0.02	11/21/2007

**SEED PRODUCTION RECORD****Accession:** Pierre (SD-251, PI-476980)**Name/Species:** sideoats grama, *Bouteloua curtipendula***Location:** Field E-9 (continued)**Year of Establishment:** 1977**Origin/Source:** Stanley County; Ft. Pierre, South Dakota

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs) Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Other Crop</u>	<u>Test Date</u>
2008	Foundation	C80610	L2803368	1.1	163.0	95.93	72	13	4.07	0.00	0.00	12/1/2008
2009	Foundation	C90499	L2902996	1.1	169.0	98.27	83	1	1.73	0.00	0.00	12/28/2009
2010	Foundation	C10797	L1004521	1.10	232.0	96.44	75	14	3.56	0.00	0.00	1/24/2011
2011	Foundation	C22115	L1105866	1.10	94.0	94.66	87	3	5.32	0.02	0.00	1/25/2012
2012	Foundation	C24915	L1203989	1.10	238.0	98.78	78	9	1.22	0.00	0.00	1/3/2012
2013	Foundation	C28485	L1302334	1.10	185.0	94.37	54	14	5.60	0.03	0.00	11/29/2013

**SEED PRODUCTION RECORD****Accession:** Pierre (SD-251, PI-476980)**Name/Species:** sideoats grama, *Bouteloua curtipendula***Location:** Field E-11**Year of Establishment:** 2009**Origin/Source:** Stanley County; Ft. Pierre, South Dakota

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs) Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Other Crop</u>	<u>Test Date</u>
2010	Foundation	C10992	L1005405	1.10	307.0	95.34	84	3	4.66	0.00	0.00	2/8/2011
2011	Foundation	C22247	L1106179	1.10	190.0	94.14	72	5	5.86	0.00	0.00	1/31/2012
2012	Foundation	C25071	L1204417	1.10	404.0	99.4	90	2	0.59	0.00	0.01	1/23/2013
2013	Foundation	C28474	L1302210	1.10	314.0	90.66	54	12	9.29	0.05	0.00	11/26/2013

**SEED PRODUCTION RECORD****Accession:** Bad River ecotype (9063064)**Name/Species:** blue grama, *Bouteloua gracilis***Location:** Field E-12**Year of Establishment:** 2010**Origin/Source:** Haakon County; Philip, South Dakota

<b>Prod.</b>	<b>App./Cert.</b>	<b>Seed</b>	<b>Bulk (lbs)</b>							<b>Other</b>	<b>Test</b>		
<b>Year</b>	<b>Seed Class</b>	<b>No.</b>	<b>Lab No.</b>	<b>Acres</b>	<b>Quantity</b>	<b>Purity</b>	<b>Germ.</b>	<b>Dorm.</b>	<b>Inert</b>	<b>Weed</b>	<b>Crop</b>	<b>Date</b>	<b>Notes</b>
2010	no harvest-establishment year			1.02									
2011	Select	C22849	L1108133	1.00	100.0	95.96	96	0	3.92	0.08	0.04	3/7/2012	
2012	Select	C24477	L1202783	0.70	16.0	76.61	68	13	23.33	0.03	0.03	12/4/2012	
2013	Select	29198	L1305263	1.00	114.0	96.69	86	2	3.18	0.13	0.00	2/21/2014	

**SEED PRODUCTION RECORD**

**Accession:** 9094357

**Name/Species:** Prairie sandreed, *Calamovilfa longifolia*

**Location:** Field E-9

**Year of Establishment:** 2009

**Origin/Source:** composite, Sherburne, Polk, Norman, Douglas, Chisago Counties, Minnesota

<b>Prod.</b>		<b>App./Cert.</b>	<b>Seed</b>		<b>Bulk (lbs)</b>						<b>Other</b>	
<u>Year</u>	<u>Seed Class</u>	<u>No.</u>	<u>Lab No.</u>	<u>Acres</u>	<u>Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Crop</u>	<u>Test Date</u>
2010	breeder			0.25	85 gm							
2011	breeder		No test	0.25	1.2							
2012	breeder		L1202345	0.25	2.5	66.84	69	0	30.08	3.08	0.00	11/26/2012
2013	breeder		L1302415	0.25	7	74.62	76	0	24.72	0.34	0.32	11/20/2013

**SEED PRODUCTION RECORD****Accession:** Bismarck germplasm (9006032)**Name/Species:** purple prairieclover, *Dalea purpurea***Location:** E-12**Year of Establishment:** 2009**Origin/Source:** Lyman County; Presho, South Dakota

<b>Prod. Year</b>	<b>Seed Class</b>	<b>App./Cert. No.</b>	<b>Seed Lab No.</b>	<b>Acres</b>	<b>Bulk (lbs)</b>				<b>Other</b>	<b>Test Date</b>		
					<b>Quantity</b>	<b>Purity</b>	<b>Germ.</b>	<b>Dorm.</b>	<b>Inert</b>	<b>Weed</b>	<b>Crop</b>	
2010	no harvest	S1010037		0.5								
2011	Select	C23683	L1111282	0.5	44	99.01	29	0	0.99	0.00	0.00	5/16/2012
2012	Select	C25241	L1204921	0.5	12.5	98.57	31	48	1.4	0.03	0.00	2/6/2013
2013	No Harvest											

**SEED PRODUCTION RECORD****Accession:** Bismarck germplasm (9076759)**Name/Species:** narrow-leaved purple coneflower, *Echinacea angustifolia***Location:** E-12**Year of Establishment:** 2009**Origin/Source:** composite; McKenzie, Slope, Sioux, Billings, Dunn, Burleigh, Sheridan, Morton, McHenry Counties in North Dakota

<b>Prod.</b>		<b>App./Cert.</b>	<b>Seed</b>		<b>Bulk (lbs)</b>						<b>Other</b>	<b>Test</b>	
<b>Year</b>	<b>Seed Class</b>	<b>No.</b>	<b>Lab No.</b>	<b>Acres</b>	<b>Quantity</b>	<b>Purity</b>	<b>Germ.</b>	<b>Dorm.</b>	<b>Inert</b>	<b>Weed</b>	<b>Crop</b>	<b>Date</b>	<b>Notes</b>
2010	no harvest	S1010036		0.32	0								
2011	Select	C22850	L1108134	0.1	73	84.96	15	49	15.04	0.00	0.00	3/5/2012	
2012	Select	C25542	L1205976	0.1	5	81.79	39	35	18.21	0.00	0.00	2/20/2013	
2013	Not tested-too dirty				8								

**SEED PRODUCTION RECORD**

**Accession:** 'Mandan' (9058908)

**Name/Species:** Canada wildrye, *Elymus canadensis*

**Location:** Field D-9

**Year of Establishment:** 2008

**Origin/Source:** central North Dakota

<b>Prod. Year</b>	<b>Seed Class</b>	<b>App./Cert. No.</b>	<b>Seed Lab No.</b>	<b>Acres</b>	<b>Bulk (lbs)</b>			<b>Other</b>					<b>Test Date</b>	<b>Notes</b>
					<b>Quantity</b>	<b>Purity</b>	<b>Germ.</b>	<b>Dorm.</b>	<b>Inert</b>	<b>Weed</b>	<b>Crop</b>			
2009	Foundation	C91719	L2908364	1.0	467.0	96.57	76	0	3.43	0.00	0.00	4/14/2010		
2010	Common*	C11887	L1008287	0.87	86.0	92.93	67	0	7.06	0.00	0.01	4/19/2011		
2011	Foundation	C23742	L1111529	0.9	159.0	97.17	81	0	2.83	0.00	0.00	6/28/2012	ergot 0.04%	
2012	Foundation	C25400	L1205502	0.9	179.0	94.63	70	0	5.36	0.01	0.00	3/4/2013	ergot 0.02%	
2013	Foundation	C94254	L1308465	0.9	142.0	96.69	89	0	3.29	0.01	0.01	5/7/2014	ergot 1.75%	

\* failed certification due to low germination

## SEED PRODUCTION RECORD

**Accession:** Medicine Creek germplasm (ND-3651, 9008065)

**Name/Species:** Maximilian sunflower, *Helianthus maximiliani*

**Location:** Field D-11

**Year of Establishment:** 1983/1985

**Origin/Source:** Hughes County, South Dakota

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs)</u>		<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Other Crop</u>	<u>Test Date</u>	<u>Notes</u>
1983	Common		K11447	0.05	3.5	97.03	18		2.90	0.00	0.07	4/27/1984	
1984	Common		K31783	0.05	6.0	91.85	23		4.76	3.39	0.00	5/31/1985	
1985	Common		L9742	0.63	15.0	79.29	41		20.51	0.71	0.03	4/21/1986	
1986	Common		L28597	0.63	8.0	78.05	20		18.21	3.68	0.06	4/2/1987	
1987	Common		M20825	0.63	13.0	71.82	6		27.99	0.15	0.04	5/20/1988	
1988	Common		N17895	0.70	1.3	99.46	11		0.54	0.00	0.00	4/3/1990	
1989	Common		N20601	0.70	4.5	62.66	5		37.24	0.06	0.04	5/4/1990	
1990					0.0								
1991	Common		P03393/P03590	0.70	86.5	92.12	65 (TZ)		7.02	0.86		7/29/1992	
1992	Common		P17831	0.70	31.0	88.38	1	47	11.03	0.59	0.00	5/11/1993	
1993	Common		9312790	0.70	40.5	83.14	1	18	16.57	0.29	0.00	6/13/1994	
1994	Common		9402979	0.70	70.5	84.69	0	63	13.92	1.39	0.00	11/14/1994	
1995	Common		9513275	0.70	31.0	93.57	18	67	5.18	1.25	0.00	3/25/1996	
1996	Common		9604738	0.70	35.5	83.66	15	48	16.05	0.29	0.00	12/19/1996	
1997	Common		9709183	0.70	64.0	83.20	4	70	16.75	0.05	0.00	3/2/1998	
1998	Common		9811399	0.70	96.5	94.27	30	64	5.26	0.47	0.00	4/13/1999	
1999	Select (G1)	990870-1	9909471	0.70	26.0	98.45	18	39	0.68	0.86	0.01	3/20/2000	
2000	Select (G1)	201147-1	2005815	0.70	20.0	98.08	25	60	1.47	0.46	0.00	2/5/2001	
2001	Select (G1)	S0113843	2105127	0.70	15.5	98.10	58	27	0.94	0.96	0.00	1/23/2002	
2002	Select (G1)	S0210293	L2203526	0.70	40.0	95.71	12	79	4.15	0.13	0.01	12/20/2002	
2003	Select (G1)	C56405	L2310636	0.70	60.0	99.02	33	56	0.34	0.58	0.06	4/16/2004	
2004	Select (G1)	S0412050	L2410471	0.70	27.0	91.55	43	54	4.04	4.39	0.02	3/28/2005	
2005	Select (G1)	S0513084	L2503953	0.70	57.0	98.17	6	74	1.12	0.71	0.00	12/27/2006	
2006	Select (G1)	C66808	L2607438	0.70	18.0	91.38	35	38	8.45	0.05	0.12	2/21/2007	
2007	Select (G1)	C71064	L2710351	0.70	48.0	96.26	5	73	3.72	0.02	0.00	4/8/2008	
2008	Select (G1)	C80746	L2804221	0.70	37.0	98.37	4	53	1.61	0.02	0.00	1/1/2009	
2009	Select (G1)	C92148	L2910721	0.70	69.0	98.78	19	67	0.61	0.3	0.31	4/23/2010	

**SEED PRODUCTION RECORD**

**Accession:** Medicine Creek germplasm (ND-3651, 9008065)

**Name/Species:** Maximilian sunflower, *Helianthus maximiliani*

**Location:** Field D-11 (continued)

**Year of Establishment:** 1983/1985

**Origin/Source:** Hughes County, South Dakota

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs) Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Other Crop</u>	<u>Test Date</u>	<u>Notes</u>
2010	Select (G1)	C1176	L1007816	0.70	40.0	99.69	21	68	0.28	0.01	0.01	3/15/2011	
2011	Select	C24039	L1200284	0.70	14.0	96.18	3	23	3.82	0.00	0.00	8/21/2012	on hold
2012	Select	C25750	L1206678		20.0	99.44	61	18	0.42	0.14	0.00	3/22/2013	
2013	FIELD REMOVED												

**SEED PRODUCTION RECORD**

**Accession:** Bismarck germplasm (9047233)

**Name/Species:** stiff sunflower, *Helianthus pauciflorus* ssp. *pauciflorus*

**Location:** Field E-12

**Year of Establishment:** 2009

**Origin/Source:** composite

<b>Prod.</b>		<b>App./Cert.</b>	<b>Seed</b>		<b>Bulk (lbs)</b>				<b>Other</b>				
<u>Year</u>	<u>Seed Class</u>	<u>No.</u>	<u>Lab No.</u>	<u>Acres</u>	<u>Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Crop</u>	<u>Test Date</u>	<u>Notes</u>
2009	Select (G1)	C91409	L2906675	0.22	9	90.15	13	48	9.84	0.01	0.00	3/16/2010	
2010	Select (G1)	C10494	L1003258	0.09	10.0	96.08	20	72	3.92	0.00	0.00	12/16/2010	
2011	Common	Failed	L1107298	0.09	3.0	70.40	12	26	29.59	0.01	0.00	2/21/2012	
2012	Select-hold	C25508	L1205823	0.09	3.0	78.10	5	24	21.78	0.12	0.00	2/27/2013	excess weeds
2013	Common	Not tested-too dirty			6.0								

**SEED PRODUCTION RECORD**

**Accession:** 'Forestburg' (SD-149, PI-478001)

**Name/Species:** switchgrass, *Panicum virgatum*

**Location:** Field D-11

**Year of Establishment:** 1999

**Origin/Source:** Sanborn County; Forestburg, South Dakota; composite of SD-62, 205, 206, 203

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs)</u>					<u>Other</u>			<u>Test Date</u>
					<u>Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Crop</u>		
2000	Foundation	201163-1	2010929	1.2	776	99.96	77	3	0.02	0.02	0.00		4/18/2001
2001	Foundation	S0113837	2111414	1.2	840	99.95	82	0	0.05	0.00	0.00		4/22/2002
2002	Foundation	S0210302	L2205339	1.2	144	99.82	49	29	0.16	0.02	0.00		1/31/2003
2003	Foundation	C56259	L2310164	1.2	157	99.16	88	7	0.72	0.07	0.05		4/22/2004
2004	Foundation	S0412032	L2415348 L2506244	1.2	476.5	99.47	68	2	0.51	0.02	0.00		5/19/2005
2005	Foundation	S0513082	L2515485	1.2	591	98.89	70	0	1.09	0.02	0.00		7/10/2006
2006	Foundation	C67586	L2610436	1.2	200	99.87	87	5	0.11	0.02	0.00		4/20/2007
2007	Foundation	C69781	L2704963	1.2	644	99.9	73	11	0.1	0	0.00		2/5/2008
2008	Foundation	C81522	L2807508	1.2	287	99.82	82	1	0.18	0	0.00		4/1/2009
2009	Foundation	C90828	L2904378	1.2	678	99.86	60	5	0.07	0.07	0.00		2/17/2010
2010	Foundation	C11624	L1007359	1.2	585	99.98	87	2	0.02	0	0.00		4/1/2011
2011	No harvest												
2012	Failed-common	C25938	L1207292	1.2	222	99.29	87	8	0.02	0.69	0.00		4/23/2013
2013	FIELD REMOVED												

**SEED PRODUCTION RECORD**

**Accession:** 'Rodan' (PI-477993)

**Name/Species:** western wheatgrass, *Pascopyrum smithii*

**Location:** Field E-7

**Year of Establishment:** 2007

**Origin/Source:** Field in Morton County; Mandan North Dakota

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs) Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Other Crop</u>	<u>Test Date</u>	<u>Notes</u>
2009	Foundation	C90741	L2903919	1.0	137.0	91.45	92	1	8.42	0.08	0.05	2/8/2010	
2010	Foundation	C11362	L1006544	1.3	180.0	92.30	84	0	7.70	0.00	0.00	3/24/2011	ergot 0.93%
2011	Foundation	C21309	L1102287	1.3	125.0	85.41	61	1	14.57	0.02	0.00	3/20/2012	
2012	Foundation	C24478	L1202784	1.3	66.0	93.56	71		6.44	0.00	0.00	12/15/2012	
2013	Foundation	C28736	L1303203	1.3	68.0	86.46	70	5	13.54	0.00	0.00	1/9/2014	ergot 2.02%

**SEED PRODUCTION RECORD**

**Accession:** 'Rodan' (PI-477993)

**Name/Species:** western wheatgrass, *Pascopyrum smithii*

**Location:** Panel A

**Year of Establishment:** 2010

**Origin/Source:** Morton County, North Dakota

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs) Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Other Crop</u>	<u>Test Date</u>	<u>Notes</u>
2007	Breeder		L2705642	0.1	13	94.31	87	1	5.68	0.01	0.00	2/20/2008	
2008	Breeder	No Test		0.1	1.6								
2009	Breeder	No Test		0.1	1								
2010	Breeder		L1003845	0.1	4.0	87.11	65	1	12.79	0.11	0.00	1/17/2011	
2011	Breeder	No Test		0.1	2.0								
2012	Breeder		L1203148	0.1	3.0	86.54	44		13.09	0.01	0.36	12/27/2012	
2013	Breeder		L1302243	0.1	2.0	75.93	37	5	24.07	0.00	0.00	12/10/2013	

## SEED PRODUCTION RECORD

**Accession:** 'Badlands' ecotype (ND-4115, 9036131)

**Name/Species:** little bluestem, *Schizachyrium scoparium*

**Location:** Field E-13 (adjacent to breeder's block)

**Year of Establishment:** 1989

**Origin/Source:** western North Dakota and western and central South Dakota

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs) Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Other Crop</u>	<u>Test Date</u>
1990	Common		N8367	0.90	28.00	87.89	79	0	12.11	0.00	0.00	4/16/1991
1991	Common		P03212	0.90	78.50	64.08	59	0	35.92	0.00	0.00	5/28/1992
1992	Common		P16680	1.04	199.50	95.86	87	0	4.14	0.00	0.00	5/6/1993
1993	Common		9307613	1.04	83.00	93.94	78	0	6.06	0.00	0.00	4/13/1994
1994	Select (G2)	no tags	9415448	1.04	81.50	95.82	81	0	4.18	0.00	0.00	5/8/1995
1995	Select (G2)	9508543	9508543	1.04	60.00	87.14	67	0	12.84	0.02	0.00	2/21/1996
1996	Select (G2)	960047-1	9606987	2.17	113.00	86.11	75	0	13.85	0.02	0.02	2/18/1997
1997	Select (G2)	970040-1	9705283	2.17	221.50	93.87	80	0	6.13	0.00	0.00	1/23/1998
1998	Select (G2)	980064-1	9810818	2.17	53.00	66.21	72	0	33.75	0.02	0.02	4/19/1999
1999	Select (G2)	990861-1	9911692	2.17	210.00	74.00	70	0	25.98	0.00	0.02	5/1/2000
2000	Select (G2)	201157-1	2002928	2.17**	108.50	89.69	84	1	10.31	0.00	0.00	12/27/2000
2000	Select (G2)	201157-1	2003249	12 rows	52.00	93.70	84	0	6.26	0.02	0.02	1/3/2001
2001	Select (G2)	S0113840	2111940	2.17	247.00	92.60	88	0	7.38	0.02	0.00	5/2/2002
2002	Select (G2)	S0210304	L2209496	2.17	334.00	92.45	75	2	7.55	0.00	0.00	3/25/2003
2003	Select (G2)	C55305	L2306970	2.17	365.00	95.94	84	3	4.06	0.00	0.00	2/23/2004
2004	Select (G2)	S0412039	L2406861	2.20	89.00	95.98	71	16	3.85	0.15	0.02	2/22/2005
2004	Select (G2)	S0412039	L2406860	2.20	224.00	96.83	67	16	3.17	0.00	0.00	2/15/2005
2005	Select (G2)	S0513073	L2505889	2.20	390.00	93.79	79	7	6.19	0.02	0.00	1/31/2006
2006	Select (G2)	C66297	L2605801	2.20	241.00	94.17	65	24	5.81	0.00	0.02	1/25/2007
2007	Select (G2)	C71147	L2710754	2.20	227.00	92.66	66	20	7.19	0.13	0.02	4/14/2008
2008	Select (G2)	C82181	L2810250	2.20	90.00	95.14	86	0	4.69	0.17	0.00	4/30/2009
2009	Select (G2)	C10612	L1003847	2.20	217.00	97.15	84	2	2.77	0.09	0.00	1/3/2011
2010	Select (G2)	C10611	L1003846	2.20	78.00	92.58	82	9	7.29	0.13	0.00	1/3/2011
2011	No Harvest											
2012	Select (G2)	C25751	L1206679	2.20	131.00	97.42	67	9	2.56	0.02	0.00	3/26/2013
2013	Select (G2)	C94581	L1309764	2.20	225.00	92.48	76	5	7.50	0.00	0.02	5/27/2014

\*1992 and 1993 harvest is a composite of field and 340-plant breeder's block

\*\*This acreage amount includes the 12 rows sprayed with Plateau herbicide

## SEED PRODUCTION RECORD

**Accession:** 9094396

**Name/Species:** Cupplant, *Silphium perfoliatum*

**Location:** D-10 (deer fence)

**Year of Establishment:** 2012

**Origin/Source:** Ransom County, North Dakota

<b>Prod.</b>		<b>App./Cert.</b>	<b>Seed</b>		<b>Bulk (lbs)</b>					<b>Other</b>		
<u>Year</u>	<u>Seed Class</u>	<u>No.</u>	<u>Lab No.</u>	<u>Acres</u>	<u>Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Crop</u>	<u>Test Date</u>
2013	Common		L1307294	0.10	45.0	89.75	26	37	10.25	0.00	0.00	4/10/2014

**SEED PRODUCTION RECORD****Accession:** 'Red River' germplasm (9069159)**Name/Species:** prairie cordgrass, *Spartina pectinata***Location:** Field E-7**Year of Establishment:** 2010**Origin/Source:** North Dakota, South Dakota, and Minnesota

<b>Prod.</b>		<b>App./Cert.</b>	<b>Seed</b>		<b>Bulk (lbs)</b>						<b>Other</b>	
<b>Year</b>	<b>Seed Class</b>	<b>No.</b>	<b>Lab No.</b>	<b>Acres</b>	<b>Quantity</b>	<b>Purity</b>	<b>Germ.</b>	<b>Dorm.</b>	<b>Inert</b>	<b>Weed</b>	<b>Crop</b>	<b>Test Date</b>
2010	No Harvest			1.25								
2011	Select	C24001	L1200003	1.25	45.0	90.96	53	37	9.01	0.03	0.00	7/24/2012
2012	Select	C25431	L1205621	1.25	50.0	97.76	6	74	2.06	0.17	0.01	3/26/2013
2013	Select	C29610	L1306521	1.25	95.0	54.91	15	66	45.06	0.00	0.03	3/25/2014

**SEED PRODUCTION RECORD****Accession:** 9094398**Name/Species:** prairie dropseed, *Sporobolus heterolepis***Location:** Field D10 (north of deer fence)**Year of Establishment:** 2010**Origin/Source:** composite of large seed from ND, SD, MN

<b>Prod.</b>		<b>App./Cert.</b>	<b>Seed</b>		<b>Bulk (lbs)</b>						<b>Other</b>	
<b>Year</b>	<b>Seed Class</b>	<b>No.</b>	<b>Lab No.</b>	<b>Acres</b>	<b>Quantity</b>	<b>Purity</b>	<b>Germ.</b>	<b>Dorm.</b>	<b>Inert</b>	<b>Weed</b>	<b>Crop</b>	<b>Test Date</b>
2010	Breeder				58 gm	no test						
2011	Breeder				1062 gm	no test						
2012	Breeder	none	L1202344	0.1	5	97.59	35	6	2.18	0.23	0.00	12/3/2012
2013	Breeder	none	L1302041	0.1	12.5	96.75	71	0	3.25	0.00	0.00	12/11/2013

**SEED PRODUCTION RECORD****Accession:** 9094358**Name/Species:** Indiangrass, *Sorghastrum nutans***Location:** Field D-11**Year of Establishment:** 2010**Origin/Source:** MN and SD

<b>Prod.</b>	<b>App./Cert.</b>	<b>Seed</b>	<b>Bulk (lbs)</b>				<b>Other</b>						
<b>Year</b>	<b>Seed Class</b>	<b>No.</b>	<b>Lab No.</b>	<b>Acres</b>	<b>Quantity</b>	<b>Purity</b>	<b>Germ.</b>	<b>Dorm.</b>	<b>Inert</b>	<b>Weed</b>	<b>Crop</b>	<b>Test Date</b>	<b>Notes</b>
2011	reselection within population												
2012	Breeder		L1208128	0.1	17.0	97.21	4	43	2.78	0.01	0.00	4/23/2013	
2013	Breeder		L1309369	0.1	43.0	88.15	1	70	11.81	0.03	0.01	5/12/2014	

**SEED PRODUCTION RECORD****Accession:** 'Manifest'**Name/Species:** pubescent wheatgrass, *Thinopyrum intermedia***Location:** Field E-12**Year of Establishment:** 2006**Origin/Source:** USDA, ARS, Mandan, North Dakota

<b>Prod.</b>		<b>App./Cert.</b>	<b>Seed</b>		<b>Bulk (lbs)</b>						<b>Other</b>	
<b>Year</b>	<b>Seed Class</b>	<b>No.</b>	<b>Lab No.</b>	<b>Acres</b>	<b>Quantity</b>	<b>Purity</b>	<b>Germ.</b>	<b>Dorm.</b>	<b>Inert</b>	<b>Weed</b>	<b>Crop</b>	<b>Test Date</b>
2007	Foundation	C70776	L2709076	1.2	708.0	97.86	92	0	2.02	0.01	0.11	4/1/2008
2008	Foundation	C80609	L2803367	1.2	331.0	98.64	88	0	1.35	0.00	0.01	1/1/2009
2009	Foundation	C91062	L2905217	1.2	462.0	94.96	85	0	5.04	0.00	0.00	3/3/2010
2010	Foundation	C10796	L1004520	1.3	500.0	98.79	97	0	1.21	0.00	0.00	2/7/2011
2011	Foundation	C23684	L1111283	1.3	150.0	98.40	95	0	1.60	0.00	0.00	5/30/2012
2012	Foundation	C26156	L1208127	1.3	394.0	94.41	97	0	5.59	0.00	0.00	5/1/2013
2013	Foundation	C94382	L1309088	1.3	673.0	98.57	92	0	1.43	0.00	0.00	5/15/2014

## SEED PRODUCTION RECORD

**Accession:** 'Reliant' (Mandan-1813, PI-556987)

**Name/Species:** intermediate wheatgrass, *Thinopyrum intermedia*

**Location:** Field D-7

**Year of Establishment:** 1989

**Origin/Source:** USDA, ARS, Mandan, North Dakota

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs)</u>			<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Other Crop</u>	<u>Test Date</u>
1990	Foundation	1673	N12763	0.92	397.0	99.39	94		0.61	0.00	0.00	6/27/1991	
1991	Foundation	2144	N16914	0.92	171.5	98.33	90		1.65	0.01	0.01	12/17/1991	
1992	Foundation	1044-1	P09589	0.92	157.0	98.23	90		1.77	0.00	0.00	2/2/1993	
1993	No harvest			0.92									
1994	Foundation	940234-1	9407584	0.92	96.5	97.33	98		2.67	0.00	0.00	2/6/1995	
1995	Foundation	950192-1	9510849	0.92	286.5	97.39	85	0	2.59	0.01	0.01	3/12/1996	
1996	Foundation	960048-1	9606991	0.92	218.5	93.51	92	0	6.49	0.00	0.00	2/13/1997	
1997	Foundation	970039-1	9705284	0.92	383.0	98.73	98	0	1.27	0.00	0.00	1/14/1998	
1998	Foundation	981858-1	9806829	0.92	360.0	98.09	97	0	1.91	0.00	0.00	2/26/1999	
1999	Foundation	990856-1	9906202	0.92	260.0	96.55	96	0	3.44	0.00	0.01	2/22/2000	
2000	Foundation	201146-1	2006168	0.92	150.0	96.09	93	0	3.89	0.02	0.00	2/20/2001	
2001	No harvest - hail												
2002	Foundation	S0210288	L2208213	0.92	123.0	98.33	96	0	1.66	0.01	0.00	3/3/2003	
2003	Foundation	C56315	L2310270	0.92	223.0	97.74	88	0	2.24	0.01	0.01	4/22/2004	
2004	Foundation	C59967	L2409682	0.90	181.0	97.34	94	XX	2.63	0.00	0.03	4/4/2005	
2005	Foundation	C61875	L2502733	0.90	150.0	96.04	91	XX	3.95	0.01	0.00	12/21/2005	
2006	Foundation	C66479	L2606470	0.90	66.0	99.23	95	XX	0.77	0.00	0.00	2/13/2007	
2007	Foundation	C69782	L2704964	0.90	274.0	99.45	95	0	0.53	0.01	0.01	1/30/2008	
2008	Foundation	C81232	L2806510	0.90	190.0	98.40	94	0	1.60	0.00	0.00	3/18/2009	
2009	Foundation	C92474	L2911994	0.90	350.0	97.94	97	0	2.05	0.01	0.00	5/6/2010	
2010	Foundation	C11829	L1008057	0.90	182.0	98.50	97	0	1.50	0.00	0.00	4/14/2011	
2011	Foundation	C23751	L1111638	0.90	204.0	96.82	90	0	3.15	0.03	0.00	7/26/2012	
2012	Foundation	C25203	L1204768	0.90	100.0	98.29	98	0	1.69	0.00	0.02	2/14/2013	
2013	FIELD REMOVED												

## **STAFFING**

## **STAFFING: TECHNICAL REPORT 2013**

### **PERMANENT POSITIONS**

Wayne L. Duckwitz, Manager

Craig M. Stange, Forester

Nancy K. Jensen, Agronomist

Earl G. Aune, Biological Science Technician (Foreman)

Michael D. Bellon, Biological Science Technician

Rachel H. Bergsagel, Biological Science Technician

Julius C. Saylor, Office Automation Clerk

### **SEASONAL POSITIONS:**

Kevin M. Cortes, WAE, Seasonal Biological Science Aid

Joseph H. Stegmiller, WAE, Seasonal Biological Science Aid

Sage A. Malingen, WAE, Seasonal Biological Science Aid

Jacob R. Schimetz, WAE, Seasonal Biological Science Aid

## **INFORMATION**

## **INFORMATION: TECHNICAL REPORT 2013**

### **Publications - Fiscal Year 2013**

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